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WHAT IS LIFE?

OR

WHERE ARE WE

WHAT ARE WE

WHENCE DID WE COME

AND

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A PEEP INTO NATURE'S MOST HIDDEN SECRETS.

NOTICE.

THE war in South Africa has delayed the publication of the *Second* Edition of "What is Life?" This delay has enabled the author to revise his work "What is Heat?" and to add to it the consideration of the important fundamental problem, "What is Electricity?" Many new and very important fundamental experiments are described and explained, and a summary showing the actual natural reactions when gases are liquefied. The work is now published at the low price of 6*s*., by MESSRS. CHAPMAN & HALL, LTD. The title of the new edition is, "WHAT IS HEAT AND WHAT IS ELECTRICITY?"

LONDON, *November*, 1900.

with which the specialists have surrounded themselves.' Clerk Maxwell and Lord Rayleigh are especially singled out for treatment on account of their pronouncement that gravitation is not a force. . . . The last sections of the book are the most original by far. They contain a careful description of a number of very interesting experiments and observations, preceded by a 'statement of the case,' or *a priori* formulation of the author's view of the micro-cosmos. This view is nothing less than remarkable. There are very few scientific men who are prepared with anything like a complete *credo* in regard to the constitution of matter, of the still more 'elusive' quantity known as 'ether.' Mr. Hovenden has given us an object lesson of boldness in reducing the results—evidently of years of thought—to a comprehensive statement in twenty-three 'articles.' The author's most important conclusions are that 'the ether' is an 'anti-gravitating fluid'; that the atoms and molecules—the ultimate forms of matter—are of variable form and dimensions; the difference in dimensions is due to variations 'of the quantity of ether held by them at a given moment, and is what is called the *temperature* of the atom or molecule'; and lastly, that both *ether* and *molecules* may be brought to visual demonstration, may be *seen* under conditions which it has been a main

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endeavour of the author to devise. . . . In these experiments the author shows a good deal of ingenuity. Every student accustomed to the strictly quantitative methods of modern science would find himself very much puzzled by the paradoxical observations which Mr. Hovenden is able to create and put before him in such form as to be undeniable. His intuitive scepticism would at once suggest the question: Can these observations, involving not a single quantitative measurement, constitute a destructive criticism of a science which only began to move with the entrance of the quantitative method, and has progressed *pari passu* with the reduction of the phenomena to mathematical expression? His most natural criticism would be 'there must be something wrong somewhere.'"

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(6) **Science Gossip**:—"We would like to quote considerably from this work had we space available, for it is one which will interest many people. We will leave to our readers the pleasure of mastering Mr. Hovenden's own conclusions, for they would spoil by condensation. Whether they be right or whether they be wrong they are pleasantly told, and are well worth examining."

(7) **Daily Telegraph**:—"He tries to solve the problem in a serious volume, touching the subject from a variety of standpoints, but always thoughtfully, earnestly, and with the enthusiasm of an expert."

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WHAT IS LIFE?

OR

WHERE ARE WE? WHAT ARE WE?
WHENCE DID WE COME?
AND WHITHER DO WE GO?

BY

FREDERICK HOVENDEN,

F.L.S., F.G.S., F.R.M.S.

SECOND EDITION, WITH APPENDIX

WITH CUTS AND DIAGRAMS

LONDON—CHAPMAN & HALL, LD.

1899

"In the meantime, it behoves those who see more clearly than others the absolute certainty of the conclusions of science, and the inevitably fatal results to religion of staking its existence on literal interpretations which have become flatly incredible, to do their best to assist the transformation of the old dogmatic theology into a new 'Christianity without miracles,' which shall retain the essential spirit, the pure morality, the consoling beliefs, and as far as possible the venerable forms and sacred associations of the old faith, while placing them in thorough accordance with freedom of thought, and with the whole body of other truths, discovered and to be discovered, respecting the universe and man."—("Modern Science and Modern Thought," S. Laing, 1896.)

"Self-reverence, self-knowledge, self-control,
These three alone lead life to sovereign power.
Yet not for power (power of herself
Would come uncall'd for) but to live by law,
Acting the law we live by without fear;
And, because right is right, to follow right,
Were wisdom in the scorn of consequence."

(Tennyson, "*Œnone.*")

Q173
H65
1899

PREFACE.

Every deep thinker and observer of the Natural Laws is convinced that Nature is an orderly arrangement of matter and forces; that, in a word, Nature is not chaos, but cosmos. Nature may be compared to a huge picture puzzle, the little parts fitting together to make one harmonious and perfect whole. Science has been, and is now, slowly gathering together the little pieces. A time must come when these pieces can be put together by man, to form the perfect picture.

Hitherto, man has not been able to effect this object; hence arises that condition of human thought which we call the "unknowable." Hindoo sages express that which exists at and beyond the "unknowable" as "Behind the Veil." The object of this work is to lift that Veil, and view the marvellous vista beyond.

It may be we shall in part fail, but the failure will, probably, be a step by which others may be able to arrive at the end we aim at. In any case, the reader has in this volume the result of original experiments,

earnest thought, of extensive reading, and of help from contemporary workers and thinkers. It is practically the work of a life time.

There can be no doubt that the key by which the orderly phenomena of Nature can be unfolded lies in the hands of the physicist; hence the whole of the work is built up from physical phenomena.

The work is based on the author's previous book, "What is Heat?" Indeed, it is the sequel to that work.

The style adopted is that of an advocate pleading for truth, in the simplest of language. The case is first stated, and the evidence is afterwards brought in. The reader must always bear in mind that the author is only a special pleader, and may fail in obtaining a full verdict of "Proven." A negative verdict can only be obtained by the existence of strong negative evidence.

The conception of eternal molecular regeneration is the key to the solution of the problem of the penetration of the "unknowable"; it is the rope which lifts the Veil. When one grasps the stupendous stretch of time required to explain the simplest geological phenomena, one is impressed with a sense of security that the infinite terrestrial future will be as certain as (to our minds) the infinite past.

The struggle which the human being has passed through in the process of attaining to his present condition, which is a process of brain-perfecting,

brought about by necessity, experience, suffering, is horrible. When the Veil is lifted it looks like a hideous dream. Probably no book exposes this struggle so clearly as that interesting and well-written work by Winwood Reade, "The Martyrdom of Man." The student should also study the various works by S. Laing, especially "Modern Science and Modern Thought" and "Human Origins." He will then obtain definite ideas of the origins of our various religions, and a knowledge that man has existed on this world for a time which is, to the human mind, that of infinity.

For the selfish and cruel errors of the past, whereby the present views of the Universe were repudiated; how the pioneers of science, as also the weak-minded, were persecuted, tortured, and killed; how hundreds of thousands—a great unknown number—of human creatures have suffered for thinking for themselves;[1] how myths, more silly than children's fairy tales, have been imposed upon the community as fundamental truths—for these facts, the student should read Andrew Dickson White's "History of the Warfare of Science with Religion in Christendom" (1896).

For a little known, but very important, phase of the

[1] "In Germany alone, it is estimated that in the great age of witch-burning . . . more than 100,000 persons perished by an excruciating death in the course of a single century. . . . From first to last, hundreds of thousands of victims perished in horrible tortures for the crime of thinking for themselves."—("Problems of the Future," S. Laing, 1894, pp. 288, 290.)

great problem we are studying, how the producing classes are being enslaved by the financial classes by the manipulation of the currency, the student should read "The Law of Civilization and Decay," by Brooks Adams (1895); and for the coming views he should read "Social Evolution," by Benjamin Kidd.

For a most exhaustive and temperately expressed *résumé* of the pregnant questions raised by scientific investigation, see "The Creed of Science," by William Graham. To nearly every question raised, this book gives a reply.

A theory of our life is absolutely necessary. Religions are generally attempts to frame such a theory. Science has shown that such theories have hitherto not been true.

This work comes before the world in the year of the Jubilee of the reign of our esteemed Queen. It has been thought desirable to celebrate the event by some great act of benevolence—a national contribution for the further support of institutions for the mitigation of human suffering. This is altruism. The practical purport of this book is the suppression and prevention of the existence of human suffering, so that such institutions may not be required to the present extent. This also is altruism. Which is the higher altruism time will show. This book, then, is the author's contribution to the altruism which is to commemorate the Jubilee of our beloved Queen Victoria.

It is questionable if any mind can keep up with the latest phases of departmental scientific research, so to prevent any misconception as to the trustworthiness of scientific facts here adduced, the author has had the more important parts of his work, i.e. the physical, the biological, and the geological, revised by specialists of high authority. The *facts* in the text, therefore, may throughout be regarded as authoritative as well as up to date. The *co-ordination* of the facts and the *deductions* from the facts are the author's. The numerous quotations are made with the object of showing how advanced thought is progressing, by leaps and bounds, in the same order of thought as that adopted by the author.

The author's best thanks are due to the eminent specialists and other professional men who have revised the work and brought the facts up to date. The labour in most cases has been most generously given.

December 21*st*, 1897.

PREFACE TO THE SECOND EDITION.

A FEW corrections and additions have been made in this edition to bring the work up to date. The Appendix (p. 285) will be found of great interest, and adds, to the physical part of the book, the most recent information.

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POSTSCRIPT.

DURING the time the second edition was passing through the press a most important work was published, written by Prof. Max Verworn of the Jena University, Germany, and translated into English by Prof. Fredk. S. Lee of Columbia University, New York, entitled: "GENERAL PHYSIOLOGY, AN OUTLINE OF THE SCIENCE OF LIFE."[1] This work is also translated into Russian and Italian. Such a range of diffusion of original observations and thought is a far cry indeed, and indicates the rapid way "knowledge" is being spread.

Now this work *experimentally* proves the fundamental views adopted by the author in the text of "What is Life." It is gratifying that after studying Prof. Verworn's book, the author sees no reason for altering one word of the text.

The weak part of Prof. Verworn's work is the physical part, and this he feels, for he states :—

"Logic demands that every body, whether living or lifeless, must be subject to the general laws of bodies, which physics and chemistry reveal. It is evident that these two sciences are not yet completed, and that in the future many of their essential views will undergo profound changes. But so much is certain: *an explanatory principle can never hold good in physiology, with reference to the physical phenomena of life, that is not also applicable in chemistry and physics, in lifeless nature*" (p. 46).

People who are unable to believe in "spontaneous generation," that is, the evolution of the organic out of the inorganic, must shut their eyes to the most

[1] Published by Macmillan & Co., Limited.

common and widespread phenomenon, namely the evolution of plant life; it is always life evolved from inorganic matter, i.e. spontaneous generation. Prof. Verworn properly lays much stress upon this.

Nor must we overlook the scope of Prof. Verworn's book. It is not a "one-man" work. It contains the observations and experiments of numbers[1] of earnest workers, and when we reflect that these workers are generally professors having a working staff—a school, which also is observing and experimenting, it is not probably overreaching the mark if it is stated the book is the outcome of many hundreds of observers.

And more, the book is one essentially "made in Germany." Prof. Verworn barely recognises workers in England and elsewhere in the civilized world. Add these, and then some vague idea may be formed of the vast enquiry taking place to increase our "knowledge" and the evolution of "truth"—to understand our life.

Unfortunately at the present moment the religious world, the literary world, and the general public are little aware of this profound enquiry, and more, little or no weight is given to the pure and disinterested efforts of the physiologist. It should be always remembered that there are no patent laws in favour of such enquirers.

But there can be no doubt this enquiry will result, in the near future, in a most grand mental revolution—a revolution which will alter our actions—domestic, political, and international.

How much human suffering will be eliminated when this mental revolution takes place!

[1] The Bibliography attached to Prof. Verworn's book refers to 198 observers.

PART I.

THE STATEMENT OF THE CASE.

PART I.

THE STATEMENT OF THE CASE.

1. *Space, by itself, is a void and it is infinite.*

2. *Matter is that which exists in space.*

3. *All matter exists in Eternity.*

4. *Time is the measurement of terrestrial motion.*

5. *All matter consists of finite but very minute objects, called "atoms" (discrete units), which combine to form objects called "molecules" (complex units). Molecules attract molecules, and cohere to form "cells." The grouping of atoms and molecules makes "mass."*

6. *Matter, in mass, consists of two classes. The cellular, from which the so-called "organic" is mainly formed, and the non-cellular, from which the so-called "inorganic" is formed.*

7. *The combination and re-combination of atoms is called by the chemist "chemical reaction."*

8. *All chemical reaction is "regeneration" of atomic combinations and the forces arising therefrom. "Atoms" are indestructible. Thus arise "the indestructibility of Matter," and "the conservation of Energy." All nature is alive.*

9. *All "regeneration" arises from the influence of*

the prime factor—the ETHER, through which the inherent properties of the atom or molecule are made active. Hence, no Ether, no regeneration.

10. *The number of species of atoms is unknown, it is most likely an enormous number. We probably know about seventy of these species at present.*

11. *The fundamental factor in the formation of molecules, under the influence of Ether, is the selective and combining power of the strongest species of atoms.*

12. *From the combining power of the strongest species of atoms under the influence of Ether, arises the formation of cells.*

13. *Cells under the influence of the strongest cell group themselves to form highly complex structures or organisms, hence the most complex of all organisms —MAN. The activity of cells forms that activity we call Human Life. Thus Life is the sum of the activity or energy of molecules formed of atoms.*

14. *The power of the regeneration of molecules causes regeneration of cells, and this causes regeneration of Life. Life is eternal.*

PART II.

THE EVIDENCE PROVING THE STATEMENT OF THE CASE.

PART II.

THE EVIDENCE PROVING THE STATEMENT OF THE CASE.

STATEMENT No. 1.

Space, by itself, is a void and it is infinite.

We select a brilliantly clear starlight night—there is no moon visible. We examine the heavens. The mind is amazed, almost aghast with the awe-inspiring spectacle. All looks as if the world were surrounded by a huge spherical canopy, almost dark, in which are holes of various dimensions through which shines eternal light. But we now know this is not so. With few exceptions each brilliant spot is an object—a star. Each star is a sun. The apparent brilliancy of each orb gives us no idea of the sizes of the suns, for they vary in distance and in brilliancy. There are stars which dwarf our sun in magnitude. These suns are spheroidal masses of glowing matter moving in space, many probably giving more heat and light than our sun.[1]

[1] "How wonderful is the power of man! Chained down to the surface of the Earth, an intelligent atom on a grain of sand lost in the immensity of space, he invents instruments which multiply a thousandfold his vision, he sounds the depths of the ether, gauges the visible universe, and counts the myriads of stars which people it; next, studying their most complicated movements, he measures exactly their dimensions and the distances of the nearest of them from the Earth, and next deduces their masses, then, discovering in the seeming disorder of the stellar groupings reals bonds of union, he at last evolves order from apparent confusion."

"Nor is this all. Rising by a supreme flight of thought to the

These objects are always in motion—perpetual motion, but their distances are so vast that they appear fixed.[1] That which we see, does it show the confines of

most abstract speculations, he discovers the laws which regulate all celestial movements, and defines the nature of the universal force which sustains the worlds."

. . . . . .

"Nothing is more fitted to elevate the mind towards the infinite than the thoughtful contemplation of the starry vault in the silent calm of night. A thousand fires sparkle in all parts of the sombre azure of the sky. Varied in colour and brilliancy, some shine with a vivid light, perpetually changing and twinkling; others, again, with a more constant one—more tranquil and soft; while very many only send us their rays intermittently, as if they could scarce pierce the profundity of space."

"To enjoy this spectacle in all its magnificence, a night must be chosen when the atmosphere is perfectly pure and transparent—one neither illuminated by the Moon, nor by the glimmer of twilight or of dawn. The Heavens then resemble an immense sea, the broad expanse of which glitters with gold dust or diamonds."

"In presence of such splendour, the senses, mind, and imagination are alike enthralled. The impression gathered is an emotion at once profound and religious, an indefinable mixture of admiration, and of calm and tender melancholy. It seems as if these distant worlds, in shining earthwards, put themselves in close communication with our thoughts."

. . . . . .

"The Milky Way itself is nothing more than an immensely extended zone of stars, that is, of suns; since, as we know, and as we shall explain in the sequel, each star, from the most brilliant to the faintest, is a sun."

. . . . . .

"Thus, in the contemplation of celestial phenomena, the idea of infinite duration impresses itself on the mind with the same irresistible power as the idea of the infinity of space."—("The Heavens," Amedée Guillemin, 1878, pp. 1-6.)

[1] "In a thousand years, or in a hundred years, or ten years, or even in one year, a number of alterations take place in the positions

space? Are the seen stars the data of the dimensions of space? For answer let us try experiment. We

FIG. 1.—A part of the constellation of the Twins as seen through a telescope.

FIG. 2.—The same as seen by the naked eye.
(From "The Heavens," by Amedée Guillemin.)

of the fixed stars which are quite perceptible to the refined measurements of the modern observatory, though they would not suffice

take an ordinary opera glass. We select almost any spot in the heavens. We look, by means of the instrument, at that *one* visible star which we see by the naked eye. The instrument immediately tells a tale. There is seen not one star, but several. What have we done? Simply amplified the human power of vision, put, as it were, a compound artificial lens to the lens of the eye, and the apparent confines of space go further away. Again we repeat the experiment, we look through the finder of a small astronomical telescope. New stars—new suns, open into view. We look into the instrument itself, and many stars are seen until with the largest instruments an absolutely luminous background of suns appears. And so, as we go on increasing our power of penetration, does space expand, and there can be no doubt that as we are able to increase that power, so will new and more distant objects come into view. New to us, but old, old as eternity, at least to our minds—Eternity.

What do these experiments teach? Only one deduction, namely, *Space is Infinite.*[1]

It does not want a telescope to tell us that this deduction is true. Our minds are so framed that we can conceive no other issue. Suppose the heavens were a spherical canopy or boundary, inside which the stars

to produce a derangement of the heavens large enough to be discernible by unassisted observation."—("In the High Heavens," Sir R. S. Ball, D.Sc., LL.D., F.R.S., 1894, p. 11.)

[1] "We cannot think of space as finite, for wherever in imagination we erect a boundary, we are compelled to think of space as existing beyond it. Thus by the incessant dissolution of limits we arrive at a more or less adequate idea of the infinity of space."—("On the constitution of Nature," "Fragments of Science." John Tyndall F.R.S. Vol. i., 1879, p. 3.)

appear. We would ask ourselves what is the limit of the boundary—is it Eternal? It must be either a wall of endless depth or there is something beyond that boundary. We cannot conceive anything else, therefore experiment and our natural reasoning agree, and the fundamental truth is told

Space is Infinite.

And yet with all this evidence there are many men reasoning metaphysically from false *a priori* data, who can believe differently, and want to give space a volume of three dimensions, to put the whole of the universe into a sort of cubical box, having the dimensions of length, breadth, and depth! Alas, the vanity of an old and waning school! How poor are such minds! But quite on a par with the now obsolete notion that this wonderful grand infinite expanse and the objects therein were created with the sole purpose of giving light by day and light by night, to that insignificant object, the human being.

Besides the suns—planets, nebulæ and other objects are seen in space.[1]

[1] "The stars are suns, and are most likely surrounded by planets. One planet belonging to Sirius has been discovered. It was predicted by Bessel, its position calculated by Peters, and seen by Alvan Clark in 1862. Another predicted one, belonging to Procyon, has not yet been seen."—("Pioneers of Science," Professor O. Lodge, F.R.S., 1893, p. 304.)

"Each star is itself, in all probability, the centre of another and distinct solar system, the constituents of which are too dark and far off to be visible to us; nothing visible here but the central sun alone, and that only as a twinkling speck."—(*Idem*, p. 331.)

"These orbs will be found in every phase possible to such bodies; but the enormous majority of them must, in accordance with the

When the moon is examined by a good telescope the mind cannot get away from the idea that it is a

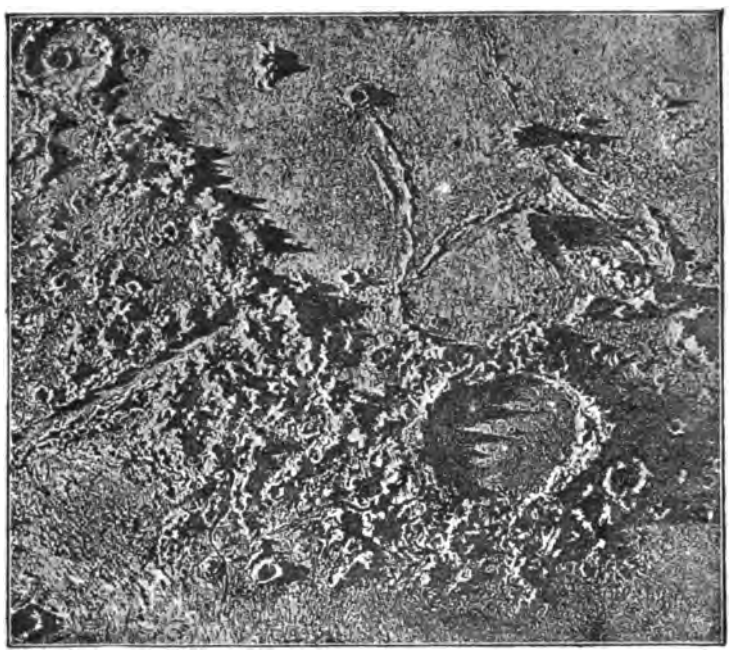


FIG. 3.—Portion of the lunar surface, highly magnified, showing the shadows of a mountain range, deep pits, and other details. From "Pioneers of Science," by Prof. O. Lodge, F.R.S., 1893, p. 98.

solid body moving in space, similar to our earth. We see the great mountains often with their craters, apparently

principles just laid down, be in the dark and invisible state. Out of some millions it may perhaps be concluded that, at any particular moment, a dozen or so might, by accidental circumstances, be in those phases of their several careers in which luminosity is a characteristic. In such cases only will the orbs be visible. The instructed astronomer will, therefore, believe that the non-visible orbs must be hundreds, thousands, or perhaps millions of times more numerous than those which he can see. When we remember that, by our telescopes and on our photographs, we can discern something

extinct volcanoes, with the sunlight giving the shadows as on our earth. An illustration helps us, but it is not equal, and cannot be equal, to seeing the object itself.

As the moon looks to the naked eye, so do the planets, the wandering stars, look when examined by the telescope. Our sun appears as a glowing mass of matter, each molecule of which it consists being in motion, a mean of ninety-two millions of miles, or thereabouts, away from us, a distance the mind cannot grasp. Yet it is so large that the very spots, huge craters in the moving, glowing mass, are often large enough to allow an object the size of our earth to pass in with a margin of thousands of miles clear on every side.

Vast glowing orb, probably the source of all terrestrial life and movement, what is thy function in the great infinity of suns—masses of molecules?

Thus, in brief, we obtain the first fundamental idea; such a one, when fully grasped, is probably retained for all time.

like one hundred million luminous stars in the sky; when we remember that every one of these is the indication of a wholly exceptional incident in the career of the body from which the light emanates; and when we further believe, as believe we must, that for each one star which we can thus see there must be a stupendous number of invisible masses, then, indeed, we begin to get some notion of the extraordinary multitude in which material orbs are strewn through space. The theory of probabilities declares to us with a certainty, hardly, in my opinion, inferior to that of optical demonstration, that even within the distance which can be penetrated by our telescopes the visible stars cannot form the hundredth, probably not the thousandth, perhaps not the millionth part of the total quantity of matter."—("In the High Heavens," Sir Robert Ball, D.Sc., LL.D., F.R.S., 1894, p. 246.)

STATEMENT No. 2.

"*Matter is that which exists in space.*"

In contrast to the continuity and infinity of space stands the discontinuity and finiteness of matter. The former may be called passive, the latter active. The activity of matter gives us sensations, ideas, our minds, our souls. The activity of matter is eternal—at least, in the ever-present it is always active. Every atom, every molecule has dimensions; each has volume. Matter is always a mass of atoms or molecules. Experiment proves this. What is terrestrial is also celestial. Every object in space has volume. Every object has dimensions. We cannot measure space without objects. We can imagine, we can measure space without objects, but such is unreal, because space is continuous. We can cut up an object, but we cannot cut up space. Matter has existed from eternity; it lasts for ever. Matter is always changing, always evolving force; matter and motion (that is, the motion of matter) are eternal.

The sciences of Chemistry and Physics prove these facts. If the above were not facts, these sciences would cease to exist.

STATEMENT No. 3.

"All matter exists in Eternity."

SUPPOSE we had the power to place ourselves from off the surface of the Earth, and select some position in space, say midway from the Sun to the Earth, about forty-six millions of miles away, and that we had the power of examining, from this neutral position, the motions of the heavenly bodies, our Earth being one of them; we would see that all are in motion, but each object in space has its special motion, thus each object differs from another in motion. We are immediately deprived of the phenomenon we call time—all objects move in eternity, therefore the motion of the earth is a motion in eternity.

For astronomers find, if we take the motion of the earth as a standard, the objects whose motions we can approximately trace, i.e. the planets, bear a ratio to the earth's motion as below.

Mercury, the nearest planet to the sun, has a day of twenty-four hours, five and a half minutes of our terrestrial time, and the year consists of about 88 days.

Venus, the next nearest planet to the sun, has a day of a little over twenty-three hours of our terrestrial time, and a year of nearly 225 days.

Then comes the Earth, which has of course our day

and year—the standard by which we are measuring the time of the motion of other bodies.

Mars, the next planet, has a day of about twenty-four and a half hours of our terrestrial time, and its year is about 687 days.

Jupiter, the next planet to Mars, has a day of nearly ten hours of our terrestrial time, and its year is about 4333 days. This planet has five moons, visible; each differs in its time of revolution round Jupiter.

Saturn, with its wonderful rings, an object apparently unique in the heavens, has a day of about ten hours terrestrial time, but Saturn's year is about 10,759 days.

So also has Uranus a day (probably about nine and a half hours), but its year consists of about 30,687 days.

Neptune also has its special day and year of 60,127 days.

Smaller masses of matter, minor planets, their number unknown, each one has its specific day and year.[1]

[1] "There seems to be a regular gradation of size, therefore, ranging from Sirius to dust; and apparently we must regard all space as full of these cosmic particles—stray fragments, as it were, perhaps of some older world, perhaps going to help to form a new one some day." —("Pioneers of Science," Prof. O. Lodge, F.R.S., 1893, p. 332.)

"There appears to be no special size suited to the vastness of space; we find, as a matter of fact, bodies of all manner of sizes, ranging by gradations from the most tremendous suns, like Sirius, down through ordinary suns to smaller ones, then to planets of all sizes, satellites still smaller, then the asteroids, till we come to the smallest satellite of Mars, only about ten miles in diameter, and weighing over some billion tons—the smallest of the regular bodies belonging to the solar system known."—(*Idem*, p. 331.)

"Between our solar system and these other suns—between each of

Comets and suns, planets and moons, each and every object in the heavens has its special motion, and each differs from the others.

When we look at the universe, from a neutral point, we find no time, only *eternity*.

Therefore—that we live in infinite space and eternity are the two prime fundamental facts which need to be impressed upon our minds, for every conception we have must be founded upon these two grand generalisations.

these suns and all the rest—there exist vast empty spaces,* apparently devoid of matter."—(*Idem*, p. 331.)

* The question: Is space filled with Ether? is not raised here. It seems difficult to believe that light from the stars could reach the earth without a medium; on the other hand, it seems equally difficult to believe a medium to exist without giving resistance (friction) to the motions of planets, etc.

STATEMENT No. 4.

Time is the measurement of terrestrial motion.

ONE of the bodies floating in space is our Earth—*the dwelling-place of Man*, for HERE WE ARE[1]—it is an object moving in an elliptical path round the sun. In about 365¼ days it makes a complete course round the sun, and we call that complete course a year. As it goes ever round and round this course it rotates. If we put a mark upon the surface of the earth, there will be a time when that mark is opposite and nearest to the sun, and the relative position of this mark through the earth's perpetual rotation recurs at stated times, and we call this recurrence a day. These are the only two definite factors. Both are motions in eternity. And

[1] "I do not think it is at all probable that a man could exist, even for five minutes, on any other planet or any other body in the universe. We know that within even the limits of our own earth, each one of us has to be provided with a constitution appropriate to a particular climate. An Eskimo is suitably placed in the arctic regions, a negro on the Equator; and were they to change places, it is hard to say whether the heat would not have killed the Eskimo even before the cold killed the negro. But such an attempt at acclimatization would be easy when compared with that which would be required before an inhabitant adapted to one globe could accommodate himself to a residence on another. Indeed, there seem to be innumerable difficulties in supposing that there can be any residence for man, or for any beings nearly resembling man, elsewhere than on his own earth."—("In the High Heavens," Sir R. S. Ball, D.Sc, LL.D., F.R.S., 1894, p. 44.)

now comes the artificial. For convenience we divide this day into twenty-four distinct parts, and we call them hours. These hours we divide into sixty parts, and we call them minutes, and these again we divide into sixty parts, and we call them seconds. We may regard the second as our unit. Thus there are 86,400 seconds in the day. This is purely arbitrary. We might, if we liked, divide the day into a million seconds. Nature has no seconds, minutes, or hours. In the main, all that Nature deals with are two motions of the planet in eternity.

Eliminating exact figures, the circumference of the earth at the equator we may take to be nearly 25,000 miles, therefore in one second a fixed point or mark at the equator moves in space nearly a third of a mile, or approximately 500 yards.[1] So that when we say we do a thing, or that a thing is done, in a second of time, all that can be meant is, the thing is done during the time a point on the circumference of the earth at the equator moves in space a little less than a third of a mile. This is our standard of time, and this is all. This motion, moreover, is not constant, so our second varies—but inappreciably. *Time, therefore, is the measurement of terrestrial motion.*

"Our fundamental standard of time is the period of the earth's rotation—the length of the day. The earth is our one standard clock: all time is expressed

[1] "At each pole there can be no velocity, but from these two points towards the equator there is a continually increasing rapidity of motion, till at the equator it is equal to a rate of 507 yards in a second." "The rate of rotation has once been much more rapid than it now is."—("Text-book of Geology," Sir Archibald Geikie, F.R.S., 3rd edition, 1893, p. 15.)

in terms of it, and if it began to go wrong, or if it did not go with perfect uniformity, it would seem a most difficult thing to discover its error, and a most puzzling piece of knowledge to utilize when found."[1]

[1] "Pioneers of Science," Professor O. Lodge, F.R.S., 1893, p. 384.

STATEMENT No. 5.

All matter consists of finite but very minute objects, called "atoms" (discrete units), which combine to form objects called "molecules" (complex units). Molecules attract molecules, and cohere to form "cells." The grouping of atoms and molecules makes "mass."

It is absolutely impossible to get away from the above grand fundamental truths. The science of chemistry rests upon it, and would cease to exist as a science if this fundamental statement were questioned. Sir Robert Ball, in a forcible way, develops the conception thus: "Take a lump of loaf sugar and crush it in a mortar, each of the fragments is, of course, a particle of sugar still. Let the operation of grinding be carried on until the entire lump has been reduced to powder of the utmost fineness, which any grinding apparatus is capable of effecting. Each of the minute particles is still, nevertheless, a fragment possessing the attributes and properties of sugar. It has the sweetness and the hardness, the solubility and the chemical composition of the original lump. There is a difference in dimensions, but no difference of any other kind. But now let us suppose that we were in possession of some pulverizing apparatus which would permit the reduction of the sugar to be carried on to an extent far greater

than that which would be obtained by the most perfect grinding-mill known to the mechanic. The sugar might be comminuted by such agency to so great an extent that the little particles into which it had become transformed could only be discerned as the smallest of specks under the most potent of microscopes. We have the best reasons for knowing that even these little specks, which are of such extreme minuteness that the original lump contained many millions of them, are still, neither more nor less than sugar.

"Up to the present stage the reduction has not transformed, so to speak, the actual nature of the material submitted to the treatment. Though the particles have been crumbled to such an extent that after any further diminution they would cease to be visible, even in the microscope, yet we can, at all events, conceive that further disintegration could be carried on. In fact, the very smallest of these grains, only just visible under the microscope, might be crushed into a thousand parts, and still each little part would not yet have lost the attributes which belonged to sugar. We have now arrived at the conception of a magnitude too small to affect any of our senses, no matter how they may be fortified by the aid of instruments. But the trituration may be conceived to be carried on one step further, until, at last, the original lump has been reduced to particles of sugar so small as to admit of no further subdivision without a total transformation in character. This is an extremely important point. It may, in fact, be regarded as one of those cardinal doctrines which it has been the glory of modern science to teach. There was a time when it was believed that the subdivision of a particle of

sugar might be carried on indefinitely. We now know that it is not the case. We know there is a certain portion so small that it cannot be again divided. I do not mean that this particle is not in itself composed of separate objects, but what I do mean is, that if, when we have an ultimate particle of sugar, it were divided into two parts, as it might be by chemical processes, neither of those two parts would be sugar or anything like sugar. They would each be something which possessed neither the hardness, nor the colour, nor the sweetness, nor, indeed, any of the attributes characteristic of the original material.

This same argument may be applied to every other substance besides that which I have taken as a first illustration."[1]

The words "*every other substance*" are very important to keep in mind. The ultimate particles of sugar, as illustrated by Sir Robert Ball, are called "*molecules.*" Now by the aid of what is called "chemical reaction," which is always a natural force, these molecules can be resolved into the elementary objects called "atoms," of which they are composed. These objects are absolutely indestructible, they are neither capable of being created nor destroyed. Atoms are eternal. There is no death for the atom.[2] Molecules are built up of atoms, but chemists

[1] "In the High Heavens," Sir Robert S. Ball, D.Sc., LL.D., F.R.S., 1894, p. 358.

[2] One of the most remarkable properties of matter. "What has been called Conservation of Matter, is the experimentally ascertained fact that no process at the command of man can destroy even a single particle of matter. Still less can it create a new one."—(Article "Matter," Chambers's Encyclopædia, 1891.)

"Natural science teaches that matter is eternal and imperishable, for experience has never shown us that even the smallest

do not know how.[1] There is death to the molecule, and birth to the molecule; and indeed chemists can take sugar and resolve it into atoms, and state of how many

particle of matter has come into existence or passed away. Where a natural body seems to disappear, as for example by burning, decaying, evaporation, etc., it merely changes its form, its physical composition or chemical combination. In like manner the coming into existence of a natural body, for example, of a crystal, a fungus, an infusorium, depends merely upon the different particles, which had before existed in a certain form or combination, assuming a new form or combination in consequence of changed conditions of existence. But never yet has an instance been observed of even the smallest particle of matter having vanished, or even of an atom being added to the already existing mass. Hence a naturalist can no more imagine the coming into existence of matter, than he can imagine its disappearance, and he therefore looks upon the existing quantity of matter in the universe as a given fact. If any person feels the necessity of conceiving the coming into existence of this matter as the work of a supernatural creative power, of the creative force of something outside of matter, we have nothing to say against it. But we must remark, that thereby not even the smallest advantage is gained for a scientific knowledge of nature. Such a conception of an immaterial force, which at the first creates matter, is an article of faith which has nothing whatever to do with human science. *Where faith commences, science ends.* Both these workings of the human mind must be strictly kept apart from each other. Faith has its origin in the poetic imagination; knowledge, on the other hand, originates in the reasoning intelligence of man. Science has to pluck the blessed fruits from the tree of knowledge, unconcerned whether these conquests trench upon the poetical imaginings of faith or not."—("The History of Creation," Prof. Ernst Haeckel, vol. i. 1892, p. 8.)

[1] "The present position of structural chemistry may be summed up in the statement that we have gained an enormous insight into the anatomy of molecules, while our knowledge of their physiology is as yet in a rudimentary condition."—(Professor R. Meldola, F.R.S., &c., President's Address, Chemical section—British Association—Ipswich, 1895.)

atoms of each species the molecule is composed, and more than that, can take the atoms, put them together *in their proper order*, and absolutely create sugar. But they cannot destroy the atom. Still further such a process can be repeated in many instances by the chemist. The synthesis, or putting together the atoms, to form the "organic" molecule, which in the ordinary course is a vital process, has now been effected in the laboratory of the chemist in about 180 instances.[1] Thus we can destroy the molecule and create the molecule. And the evidence tends to the conclusion, that man is only able to effect such alterations by the same laws—unknown as they are—as nature effects like reactions—vital processes. We can fall into the lap of Nature and by her laws repeat her actions. *We can do nothing more.*

Thus the atoms are in themselves indestructible. Now in one form of molecule, anon in another. Now building up complex objects, cells. To-day they are forming a human being, to-morrow a plant. The plant becomes disintegrated and again integrated into groups of molecules—cells—to form the beasts of the field or the birds of the air. Now, perhaps, the atoms are combining to build up a mineral which may in turn go to build up a creature in the ocean. All, all is in an eternal state of flux and change—always the grouping and re-grouping of atoms, a perpetual and eternal creation and destruction of molecules. AN ETERNAL "REGENERATION."

And thus the earth endures, immortality reigns.

[1] Professor Meldola, F.R.S., F.I.C., &c., President's Address, Chemical section—British Association Meeting—Ipswich, 1895.

What we see born or new is a transition. What we see die is a transition also.[1]

Molecules, built up of atoms, group themselves *by their inherent powers*, and the aggregate constitutes "mass." And so we call that which is tangible "*a mass of atoms or matter.*" So clear and simple is it, that it is a marvel any other view could possibly exist. For if matter were capable of being destroyed by the powers existing, the sum total or mass would speedily shrink in volume, or if matter were capable of being created, our world would increase in size very quickly.

And thus we arrive at these fundamental truths:—SPACE IS INFINITE. MATTER EXISTS IN SPACE. ALL EXISTS IN ETERNITY. TIME IS A MEASUREMENT OF TERRESTRIAL MOTION. ALL MATTER IS IN A STATE OF FLUX—ETERNAL CHANGE. *And we shall presently see,* THE *factor by which molecules are formed and resolved is the motion of a fluid called Ether.*

[1] "Bernhard Telesius (1568) says: 'The corporeal matter is the same in all things, and ever remains the same; the inert matter can be neither increased nor diminished.' And, finally, Giordano Bruno (who was burnt in Rome, 1600) says: 'What first was seed, becomes grass, then an ear, then bread, chyle, blood, semen, embryo, man, a corpse; then again earth, stone, or some other mass, and so forth. Here we perceive something which changes in all these things, and ever remains the same. Thus there really seems nothing constant, eternal, and worthy of the name of a principle but matter alone. Matter, considered absolutely, comprises all forms and dimensions. But the variety of forms which it assumes is not received from without, but is produced and engendered from within. When we say something dies, it is merely a transition to a new life, a dissolution of one combination and the commencement of another.'"—("Force and Matter," Dr. Louis Büchner, 1864, p. 14.)

STATEMENT No. 6.

Matter, in mass, consists of two classes. The cellular, from which the so-called "organic" is mainly formed, and the non-cellular, from which the so-called "inorganic" is formed.

If we make a section of a minute part of any organism, so that we can examine it under the microscope, we generally find that it is almost wholly built up of objects, called "cells." What are cells? Living groups of molecules, very minute in size—distinct living objects, almost infinite in their variety, and these living objects are mainly the objects of which organisms are built up, including man. They differ in form—sometimes elongated, spindle-shaped, of which some of the flesh or muscles of the body are partly built; sometimes star-shaped structures which secrete the solid substances of which bone consists, just as an oyster secretes its shell; sometimes flattened, lying side by side, and building up that marvellously wonderful structure, the hair; sometimes spheroidal, then pressed into a somewhat tesselated form, and then flattened, and we call the whole series of forms, skin—the flattened cells, given off at the surface of the skin, we call scurf; sometimes changing in form, at one moment in one form and anon changing to another, and we call them the white cells of the blood; sometimes coloured and

flattened or disk-like, and we call them blood corpuscles —it is these which give the colour to the blood; sometimes as minute fibres, and sometimes like a central ball throwing out fibres in all directions, their elongating fibres meeting each other, forming a perfect network like felt, of great complexity, and we have some of the factors in the structure of nerves—nerve-cells. All, however, have one fundamental characteristic, they are alive. And it is their life in the aggregate which forms that complex condition which we call human life.

But there is another peculiarity. Each cell has inside its body a more or less spherical object called the "*nucleus*," and between this object and the wall of the cell is a more or less plastic material. And besides this minor object, there is sometimes to be seen another object inside the nucleus called a "*nucleolus*." It is important that we keep this object in mind.

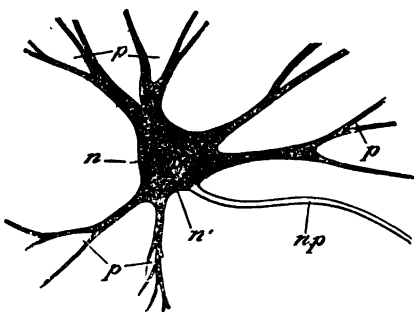


FIG. 4.—A typical nerve-cell from the spinal cord. *n* nucleus; *n'* nucleolus; *p* branched processes, the fine edges are cut away; *np* unbranched process, which connects with a nerve.—(From Huxley's "Lessons in Elementary Physiology," 1893, p. 360.)

These cells often secrete fluid, and this fluid often becomes solid, more akin to what is called inorganic material. So that an organism, a living creature, is

built up of two classes of matter, while on the other hand all matter which we call mineral matter or inorganic matter is devoid of cells. The latter are simply masses of molecules, often appearing homogeneous, while in the former case structural alterations are seen, molecules adhere to molecules, and by adhering together they form an outer skin or coat of the cell. It is not absolutely necessary for the cell to have a coat or skin. Cells often consist apparently of a viscid homogeneous clear substance—molecules attracting molecules—it is called "protoplasm."[1] Marvellously wonderful, marvellously complex, yet the microscope has proved the fact. And you, reader, and every human being, every animal you see, every creature you see on the earth, in the air above the earth, or in the waters—all are mainly built up of these cells.

And the molecules, that is, the objects of which all matter consists, are individuals having their likes and dislikes, their passive and active conditions! In mass, they have their free condition—as a fluid, their attracted condition—as a solid. And so subtle is the influence of molecules on molecules, that experiment proves that when solids are absolutely not touching each other, they are effecting operations or influences, mass upon mass (p. 75).

[1] "The protoplasmic molecule is vastly more complex than any of the compounds which we have hitherto succeeded in synthesising. It might take up and form new and unstable compounds with carbon dioxide or formic aldehyde, or sugar, or anything else, and our present methods of investigation would fail to reveal the process."—(Professor R. Meldola, F.R.S., &c., President's Address, Chemical section—British Association—Ipswich, 1895.)

When we know that this subtle influence exists, when we see the conditions by which molecules disintegrate and reform new molecules, then we get the first grand insight of the marvellously wonderful problem—What is Life?

STATEMENT No. 7.

The combination and re-combination of atoms is called by the chemist "chemical reaction."

WITH us there is no chemical reaction. It is a term used by the chemist as part of his craft. Through the division of labour, the chemist looks upon chemical reactions upon atoms and molecules, their inherent energies,—their likes and dislikes, as if they were part of his special property. We shall not take the views of the chemist, we shall look at the whole as part of one huge Cosmos called Nature. It is enough for us to know that the chemist wholly recognizes this combining and re-combining of atoms, and that it is the foundation of his science. The facts point to the definite conclusion, that there are special classes—species—of atoms, hydrogen atoms, oxygen atoms, and so forth. We only want to recollect that there are these species, and that it is these species of objects which form everything we see, i.e. mass. We want also to recollect that the combining and re-combining to form molecules is always in a definite order. Atom A and atom B unite to form one molecule called C (= AB). Present to this molecule C (= AB) an atom D under certain conditions of what is called temperature, and the molecule C will set free the atom A, and B will combine with D to form a new molecule (BD) which we will call E. And this simple idea of combination or addition of atom

to atom is the foundation of the science of chemistry, and therefore the root of all Natural phenomena.

Simple as the idea is, even with a few species of matter (and there are believed to be known about seventy of these species discovered by the chemist, but there is probably an enormous number of species), the variation of combinations of this order is of course, to our minds, infinite. Thus :—

1. Two or more atoms combine to form one molecule.

2. One molecule of two atoms combines with one molecule of two atoms, to form one molecule of three atoms, with the setting free or elimination of one atom.

3. One molecule of two atoms, combines with one molecule of three atoms, to form perhaps one molecule of five atoms, or perhaps to form one molecule of four atoms, with the setting free or elimination of one atom.

4. One molecule of three atoms combines with one molecule of four atoms, to form one molecule of seven atoms, or perhaps one molecule of five atoms, and one molecule of two atoms, or perhaps one molecule of six atoms, and one atom is let free.

And this order of combinations or groupings, and re-combinations or re-groupings, is the fundamental order in Nature as proved by the Science of Chemistry, infinite in its variety, eternal in its processes, and this is the order of things which surrounds us—nay, still more, the fundamental order of things by which we exist and have our being.

But we must notice one thing. The order of grouping is *arithmetical and rigid. Nature has no other rigidity.* This is the point to recollect. The conception that there are other rigid factors in nature is the error in the Science of Physics.

The most important fact to grasp is: the Natural system involves a successive order of higher and higher power or energy in species of atoms and molecules to permit the various so-called chemical reactions. There is a "law of the strongest" even in atomic and molecular combinations, and this is the foundation of the same law in animals and plants.

Chemists and Physicists, while fully recognizing this combining of atoms, have absolutely no idea of what is meant by this operation, and they fall upon analogy, and very useful it is, to take the place of the conception *they want* to grasp. Now this mode of reasoning by analogy, while it is very convenient and very useful, is absolutely pernicious, as it ties the mind to rigid ideas, and to conceptions which do not exist in Nature. More, these specialists are educated from youth with these rigid ideas—the brain is formed by this education. It means a serious struggle to free the mind, to give it that elasticity required in order to grasp the grand fundamental facts in Nature. And both chemists and physicists will struggle and succeed in doing this great work.

STATEMENT No. 8.

All Chemical reaction is "regeneration" of atomic combinations, and the forces arising therefrom. "Atoms" are indestructible. Thus arise "the indestructibility of Matter," and "the conservation of Energy." All Nature is alive.

We have seen that both the chemist and the physicist have failed to destroy atoms—they can only destroy the groupings—molecules. Atomic matter is thus indestructible, and every species of atom has its *inherent* properties, not only of fixed powers to combine, but specific *inherent* molecular powers *after* combination. Thus each species of atom and each species of molecule has its specific energies—producing force—atomic and molecular life. Amongst other forces is that of attraction, and the sum of the specific forces of attraction inherent in all atoms and molecules of which this earth consists, is the great factor called Terrestrial Gravitation. Not only does each so-called inorganic object, atom and molecule, have this power of attraction, but every living being (groups of molecules) does so; every animal, every vegetable which grows and dies is a factor in Terrestrial Gravitation.

The combining and re-combining or grouping and re-grouping of atoms and their inherent energies we shall call "REGENERATION" of matter and energy. And in-

asmuch as atoms cannot be destroyed, and even by the educated mind, that is, the mind educated in natural phenomena, cannot be conceived to be destroyed, it follows that *regeneration is eternal.*

Now the force pertaining to the atom and molecule is only a property, and a complex property of each of these special objects. "Force," pertinently observes Dr. Büchner, "can as little exist without a substance, as seeing without a visual apparatus, or thinking without an organ of thought."[1] "No force without matter—no matter without force! Neither can be thought of *per se;* separated, they become empty abstractions."[2] Again, "Dissolution and generation, growth and decay, proceed everywhere hand in hand—an eternal chain."[3] But both growth and decay are only forms of molecular regeneration—regeneration of substance, regeneration of force.[4] Force or "Energy is never found except in association with matter."[5]

Matter and energy are eternal, and so must be "regeneration." Matter and force and "regeneration" must have eternally existed. There is neither beginning nor end of matter, energy, force, and regeneration. When the mind carefully considers the problem, it can come to no other conclusion, and it is one of the

[1] "Force and Matter," Dr. Louis Büchner, 1864, p. 4.

[2] *Idem*, p. 2. [3] *Idem*, p. 11.

[4] "Plants abstract from the soils silica, alkalies, calcium-phosphate, and other mineral substances, which enter largely into the composition of the hard parts of animals. On the death and decomposition of animals, these substances are once more relegated to the inorganic world, thence to enter upon a new circulation through the tissues of living organisms."—("Text-book of Geology," Sir Archibald Geikie, F.R.S., &c., 3rd edition, 1893, p. 471.)

[5] Article, "Matter," Chambers's Encyclopædia, 1891.

grandest achievements of modern times to have experimentally proved the fact.

Regeneration is life. All Nature, therefore, is alive, and what we generally term "human life" is the *sum* of the forces arising from the regeneration of the molecules of which the organism, man, is composed, and so also with every other organism.

It is not possible to give too much weight to this grand deduction, for we shall presently see what vastly important issues are understood when we fully grasp the conception of *eternal regeneration.*

STATEMENT No. 9.

All "regeneration" arises from the influence of the prime factor—the ETHER, through which the inherent properties of the atom or molecule are made active. Hence, no Ether, no regeneration.

Now the problem of the day is : granted the existence of fundamental elementary atoms of an unknown number of species, how do these objects combine to form molecules?

Here we are met by one of the most important as well as the most difficult of problems. Its solution, in the division of labour, should be in the hands of the physicist. But there is an initial difficulty, entirely arising from departmental education, which prevents the physicist from grasping the important fundamental facts. The great aim of the physicist is to reduce natural phenomena to economical results, that is, to what we may call *immediate* economical results—commercial results. This is a very important object to be aimed at, but not the most important by far, for we shall see that the larger questions arising from the study of natural phenomena are absolutely the most important for our welfare, and in the end will be the most economical. The difference in the objects aimed at by us and the physicist is : whilst the physicist is striving his best to utilize the forces in Nature for increased

production, the larger view we adopt utilizes the forces of Nature as labour-saving and brain-saving powers and to produce human happiness. In a word, to reduce the mental and physical strain now existing.

The first conception we have to grasp is: what sort of things are we dealing with when we deal with these atomic objects, the existence of which is recognized both by the chemist and physicist? Both acknowledge that these objects, minute as they are, must occupy space and possess form.

Now, the physicist bases his ideas almost entirely upon mathematical formulæ, substituting arbitrary numbers for the idea of form. And very useful these formulæ are within limits, but the system is reasoning by analogy, and not reasoning from the fundamental facts. We venture to assert that we can now arrive at these fundamental facts, in part at least, by experiment, and we assert that our instruments of observation are now equal to solving the problems which we and physicists desire to solve.

The physicist has the following order of thought: whenever an experiment proves a fact or condition of things, he immediately attempts to give to the fact an arbitrary numerical value, which he does not understand. For illustration, he does not know what is meant by "temperature," but he gives an arbitrary numerical value of the unknown in the thermometer. Thus his endeavours are to reduce all natural phenomena to what he calls "numerical values," and no doubt these "numerical values" have helped the physicist very much; but they have had the misfortune of drawing his mind from the fundamental ideas or concepts explaining the facts of Nature. He becomes

simply a calculating machine. It is a physiological phenomenon. This misfortune arises from the physicist's allowing metaphysical ideas, i.e. mathematical ideas, to be his master instead of his servant.[1] In the latter capacity the science of mathematics is very useful; in the former capacity, it is absolutely mischievous and prevents progress. The physicist has departmental ideas which may be illustrated thus : he conceives that he has the power of multiplying groups of objects—masses of atoms or molecules, by groups of similar objects. Also to multiply forces by forces and inversely to divide them.

Let us illustrate the conception. An apple is a group of molecules, and so is an orange. Let us take six apples and six oranges and attempt to multiply them together to produce a "numerical value" of 36. Then take eight apples and eight oranges and try to multiply them and obtain a "numerical value" of 64. Of course we can do this on paper, but we cannot do it practically. Now these two "numerical values," viz. 36 and 64, are very useful because they are proportional

[1] "This method," i.e. the mathematical method, "when rigorously pursued, is the most powerful and satisfactory of all, and results in an ordered province of science far superior to the fragmentary conquests of experiment. But few indeed are the men who can handle it safely and satisfactorily: and none without continual appeals to experiment for verification. . . . For, observe, that the mathematical study of Nature, the discovery of truth with a piece of paper and a pen, has a perilous similarity at first sight to the straw-thrashing subtleties of the Greeks, whose methods of investigating nature by discussing the meaning of words and the usage of language and the necessities of thought, had proved to be so futile and unproductive."—("Pioneers of Science," Prof. O. Lodge, F.R.S., 1893, p. 157.)

to the prime factors. But when we ask what there is in Nature which responds to these products 36 and 64, we find there is absolutely *nothing*.

The fundamental idea is here very boldly or audaciously stated, and will probably be repudiated by some physicists; it is, however, true. We only desire to expose an *order of thought* which we think, when carried to an extreme, is pernicious, and which is, we believe, the stumbling-block to the physicist. Further illustrations will amplify this order of thought.[1]

Again, we may have a measure which holds a hundred cubic centimetres of a fluid, and the fluid may be found

[1] In the author's work "What is Heat" he severely criticizes the ideas of physicists, in attempting to express the molecular and other reactions in Nature by algebraical formulæ. *Now* physicists are questioning if it is a correct mode of procedure. See the discussion in *Nature*, in the latter part of 1896 and early part of 1897. In a letter to the editor of *Nature*, January 14th, 1897, Prof. Lodge states (quoting a reply by Mr. Cumming), "'The multiplication of one length by another length (or, more generally, of one concrete quantity by another) is abhorrent to the mind of' certain mathematicians. Quite true, I know it. The idea was abhorrent to the mind of the late Mr. Todhunter, and I think that Prof. Greenhill has expressed himself in the same sense. But what then? That is exactly why the idea requires driving home; and until it is driven home there will be no real clearness or simplicity in dealing either with physical quantities themselves or with their numerical specification in terms of given 'units.'" This is a delightfully ambiguous "definition of darkness" by Prof. Lodge. Later on (*Nature*, February 25th, 1897) Prof. Fitzgerald deals with the absurd word "mass," as used by the physicist—the definition of which he calls "huggermugger," and also draws attention to the fact that the student is "demoralized by having to swallow undigested a term of which neither he nor his teacher has a clear and distinct idea" . . . which "no fellow can understand." Thus now we are beginning to see the physicist evolving into the man of common sense.

to be of such a density that each cubic centimetre weighs exactly one gramme. Now the physicist divides the 100 grammes by the 100 cubic centimetres and obtains a quotient of the "numerical value" of 1. A very useful order of thought and one which has produced great results; but what does the unit (1), "the numerical value," represent? Why absolutely nothing in Nature. The physicist expresses the above thus, $\frac{M}{L^3}$. That is, weight is divided by volume. If we attempt to effect such a process, it is found to be impossible.

We can multiply a process, when it is repeated, by time; and every process or operation takes time. Thus, if we move an apple from one part of space to another in a second of time, and repeat that process ten times by adding apple to apple, we shall be able, in a sense, to multiply time by the objects. Thus one apple multiplied by ten units of time—the second (or apple added to apple ten times, and this is all multiplication can mean)—produces ten apples in ten seconds. In no other way can mathematics be really applied to Nature. Nature recognizes only addition to and subtraction from atoms in a certain locality, and the addition and subtraction of the forces inherent in atoms. These processes always follow in equations, thus—

If 1 apple = 1 second,
then : 10 apples = 10 seconds.

Both sides of the equation are multiplied. Even in commerce we have a similar order of things. We make an invoice thus—

	s.	*d.*
½ dozen oranges @ 12*s.* per dozen =	6	0

Now we shortly conceive an impossibility, that we can multiply 12*s.* by half a dozen oranges. In reality the conception is an equation. Thus—

Suppose one dozen oranges equal 12*s.*, then half a dozen oranges will equal the half of 12*s.*, i.e. 6*s.*

This latter amount we enter in the money column, or—

	s.	*d.*
If 1 dozen oranges =	12	0
then : $\frac{1}{2}$ dozen oranges =	6	0

And over and above the mathematical question arises what may be called the specification. Do the dozen oranges equate or are they of the value of 12*s.*? And this question of specification is one of the main sources of disagreement in commercial matters. It generally assumes the form of "The goods are not to sample." The same difficulty arises in physics, for it is the great trouble in all formulæ.

And more than this the physicist has ideas of proportion which abrogate the fundamental rules of mathematics. Thus the formula $\frac{m \times m}{d^2}$ is a true rule of three sum. Where m and m are the attracting or repulsing forces given in arbitrary numerical values from two magnets, and d^2 means the square of the distance—a very useful mode of thought within limits, but absolutely unreal in Nature. The cardinal law of the rule of three in mathematics is: proportion can only be true when the multiplier and the divisor are reduced to one and the same denomination. Now how is it possible to reduce the attraction or the repulsion of a magnet to the same value as the square of a distance?

It is like attempting to solve the problem: if one purchases 100 cheeses for £100, how many watches can one purchase for one shilling? Nay, more, what is there in Nature which can be expressed in the terms of a distance squared? Space is continuous, it cannot be squared. The surface of an object existing in space can be squared, but only in the same sense can it be done in Nature as we count the squares on a chess-board. Given so many areas of eight, and repeat those areas eight times, or add them together eight times, and we have 64 areas. Now let us amplify the idea. Suppose we could ascertain how many molecules, that is the exposed surface of those molecules, there are in each square, and suppose each square contained the same number of molecules, then it would be the $8x$ number of molecules multiplied eight times, or added together eight times $= 64x$ molecules. And this is the only way Nature recognizes mathematics.

Illustrations might be multiplied to almost any extent. Thus to multiply specific heat by atomic weight is like multiplying three pint measures by three pounds weight. The natural answer is always readily given by experiments. If we take the contents of three pint measures and three pound weights and try to multiply them together we fail. If we try to conceive what is meant by the square of a second (t^2), again the mind fails. Truly does Dr. Lodge, an eminent mathematician, state, "The height fallen by a dropped body is not proportional to the time simply, *but to what is rather absurdly called the square of the time, i.e. the time multiplied by itself.*" [1]

When we see the x^2, or whatever the symbol may

[1] "Pioneers of Science," Prof. O. Lodge, F.R.S., 1893, p. 82. The italics are ours.

represent, it always implies that it is x multiplied by x —always the same multiplied by the same, and if the symbol has a value in Nature it must mean multiplying objects by objects, time by time, distance by distance, and so on. Not one of which operations is performed in Nature, nor can be done by man. True, by artificial data we get "numerical values," and the results of multiplying and dividing these values or their ratios are called by the physicist "Dimensions."[1] These are good working formulæ up to a certain point. The equations are always *only approximate*, but in studying the problems we are dealing with we almost

[1] "Dimensions" in physical science are expressed in terms of operations by means of the following arbitrary values:—

		1		2
A definite length	=	a centimetre	or	an inch.
A definite mass	=	a gramme	or	a grain.
A definite time	=	a second	or	a minute.

If we choose the first, that is the centimetre, gramme, second, we obtain one series of numerical values—dimensions; if we choose the second we obtain altogether a different series of numerical values —dimensions. The fact is, Nature does not recognize any of these artificial (and to man very useful) distinctions. See Professor Everett's "Illustrations of the C.G.S. System of Units." It is curious to observe, in this important work, after using these three factors—the centimetre, gramme, second—in all formulæ, in the end (p. 208) the author draws attention to "*Modern Views on Electrical and Magnetic Dimensions.*" A new factor is found to be wanted which the author calls "quantity of electricity" or "specific inductive capacity," and "quantity of magnetism" or "magnetic permeability," *which are "quantities of unknown dimensions."*[1] So here the whole formulæ fail! It is this new factor, which we are contending, as will presently be seen, always exists, and we call it Ether.

[1] The italics are ours.

disregard these formulæ and confine the mind to the actual processes in Nature.

One fundamental formula used by physicists is known as Ohm's law, which is expressed thus—

$$\text{Current strength} = \frac{\text{Electro-motive force}}{\text{Resistance}}$$

Now to divide pressure (electro-motive force) by resistance is a physical impossibility.

Dr. Lodge truly states "it is an empirical relation; in other words, it has not yet "been accounted for." [1] The physicist has no idea of what exists in Nature which corresponds to the above terms, indeed it is the question of the day to get that knowledge.

But the physicist states, "I do perform these operations." The reply is, "Yes, you do *on paper*." One can write oneself, "I am the creator of the Universe" *on paper*. But would writing such an expression by an individual make him the creator of the Universe? In like manner does the physicist do the impossible on paper. All mathematical reasoning therefore is reasoning by analogy, and the physicist has strained this mode of reasoning so far that he has absolutely reasoned himself out of common sense.[2] Hence the idea of many

[1] "Modern Views of Electricity," Prof. Lodge, F.R.S., &c., 1892, p. 76.

[2] "Science is, I believe, nothing but *trained and organized common sense*, differing from the latter only as a veteran may differ from a raw recruit; and its methods differ from those of common sense only so far as the guardsman's cut and thrust differ from the manner in which a savage wields his club. The primary power is the same in each case, and perhaps the untutored savage has the more brawny arm of the two. The *real* advantage lies in the point and polish of the swordsman's weapon; in the trained eye quick to spy out the weakness of the adversary; in the ready hand prompt to follow it on

mathematicians, that space is not, matter is not, force is not—all are abstractions of a brain which they say *cannot exist*—it being matter. It must not be forgotten that mathematics is an *a priori* science, and all depends upon the reality and truth of the *a priori* definitions.[1] The physicist feels he is wrong somewhere,[2] and he craves to remedy the wrong. Few minds are able to bear the mathematical strain, because this strain is the effort to remember very complex formulæ which are not understood. Obviously, therefore, we must simplify in order to bring these great questions—questions, we shall see, upon which human progress and our common welfare depend—within the reach of ordinary intellectual minds.[3]

Mathematical formulæ are never true—from the nature of things they cannot be true. They are only numerical approximations. Let us take the formula of inverse squares—a fundamental law in physics; "the law of inverse squares is not universally true. Its truth assumes, first, that the source is a point or sphere; next, that there is no reflection or refraction of any kind; and lastly, that the medium is perfectly transparent. The law of inverse squares by no means holds from a prairie fire for instance, or from a light-house, or from a street lamp in a fog."[4] Who ever saw

the instant. But after all, the sword exercise is only the hewing and poking of the clubman developed and perfected."—("Lay Sermons, Addresses, and Reviews," Thomas Henry Huxley, LL.D., F.R.S., 1893, p. 66.)

[1] See the author's work, "What is Heat?" p. 17.

[2] See "Modern Views of Electricity," Prof. O. J. Lodge, F.R.S., &c., 1892, pp. 66, 67.

[3] See Appendix, p. 285.

[4] "Pioneers of Science," Prof. O. Lodge, F.R.S., &c., 1893, p. 209.

in Nature a sphere or a point? Even in astronomy mathematics fail. "Given," says Dr. Lodge, "three rigid spherical masses thrown into empty space with any initial motions whatever, and abandoned to gravity: to determine their subsequent motions. With two masses the problem is simple enough, being pretty well summed up in Kepler's laws; but with three masses, strange to say, it is so complicated as to be beyond the reach of even modern mathematics. It is a famous problem, known as that of 'the three bodies,' but it has not yet been solved. Even when it is solved it will be only a close approximation to the case of earth, moon, and sun, for these bodies are not spherical, and are not rigid."[1] And does not this also apply to every object in space?

And more, bodies in space do not move in undeviating paths—there are no true ellipses,[2] and the terrestrial month is slowly, very slowly altering.[3] With such facts as these before us, how can nature be interpreted by rigid ideas? These physical ideas certainly help under certain exceptional conditions, and these are all artificial—human. The science of mathematics is most valuable in tracing phenomena relating to a fluid in a water pipe or gas pipe, or a similar fluid in a copper lead. But where in Nature do we find a lead pipe or a copper lead? Let us consider the motions of the molecules of which the sea consists—now almost a calm, then a raging storm. Let us consider the like molecules pushing themselves in the air and we call them steam, or the motions of the air molecules as shown by

[1] "Pioneers of Science," Prof. O. Lodge, F.R.S., &c., 1893, p. 217.

[2] *Idem*, p. 319.

[3] *Idem*, p. 390.

the motion of smoke or of the leaves of the trees. Let us consider the motions of the molecules called clouds in their every varied form, and then ask, how can it be possible for a rigid system to interpret Natural phenomena, which ever vary, and vary always in an irregular manner?

It is very important that we should recognize this fundamental error of the physicist, *as a great deal hinges upon it.*

Arising from this rigid mode of procedure comes the conception that atoms are minute objects of *constant shape and volume.* All atoms, at least of the same species, are of the same dimensions. They are also often regarded as simply inert and passive objects—simple magnitudes.[1] Question—is this so? Proceeding with this fundamental order of thought, simply to satisfy mathematical science, the physicist attempts to build up the forces of Nature, and Nature will not respond. There is something to be admired in the bull-dog courage the physicist shows in fighting Nature against such odds. He is like a mad bull charging a solid castle called Truth. He charges and re-charges. He has now been at the work since the time of Newton —for over 200 years. He makes no progress. One can almost picture the poor creature bleeding, and the nervous tremor arising from the repeated failures. How much midnight oil has been spent to solve these problems by the insufficient weapons of the science of mathematics!

Professor W. M. Hicks, in the Presidential Address, British Association at Ipswich, 1895 (Mathematical

[1] See "The New Chemistry," Professor Cooke, LL.D., 10th edition, 1892, p. 64.

and Physical Section), states: "It is a slow and laborious process. The wreckage of rejected theories is appalling." And with this confession absolutely frankly stated, he goes on repeating the error, for he adds, "It is at present a subject"—i.e. the Kinetic theory, or the theory of the motions of *rigid* atoms—"*in which the mathematicians must lead the attack.*" [1]

In this remarkable address all manner of impossible ideas are brought forward by the physicist. A "Vortex atom theory of matter." Atoms of gross matter "composed of filaments whose rotating cores are of much greater density than the ether itself," the Atoms altering into a "spherical" condition. That is, an object which is stated to be *constant in volume and absolutely rigid*, is regarded as *constantly altering in shape!* The conceptions are fundamentally antagonistic. Then Professor Hicks follows with the same fundamental idea, to consider, "each vortex atom to be composed of a vortical mass of . . . cell-structure ether," and each cell of Ether "begins to grow." Then, more remarkable still, he regards the atom as "much larger than a cell" of Ether in which it is supposed to be imbedded! Then vortex filaments are again brought in, linked together "like helices drawn on an anchor ring." He also flies to the "vortex sponge theory of the ether," and so on, trying to give unthinkable variations of the initial fundamental idea—*the absolutely rigid atom—this is the fixed preconceived idea.*[2] All is made to satisfy

[1] The italics are ours.

[2] "Nothing can be done . . . without preconceived ideas; only there must be the wisdom not to accept their deductions beyond

mathematical science. Moreover, Professor Hicks is driven to confess that these "fundamental ideas are quite different from those underlying the well-known kinetic theory of gases of *hard*[1] atoms." Hence all is confusion. He adds that in the above contradictory notions "Extremely little progress has been made in their mathematical development, and until this has been done more completely we cannot test them as to their powers of adequately explaining physical phenomena." Now when we consider the great number of very able mathematicians existing and the wreckage of their theories which "is appalling," we can come to only one conclusion, viz. the phenomena in Nature are beyond the rigid Science of Mathematics. In fact Nature abhors the rigid.

But the mathematician is so confident that his powers are absolute, and he is so dogmatic in his tone, that he is unapproachable. He stands alone, a monument of his own creation—his own egotistical greatness. Professor Hicks, speaking on the part of the mathematical physicist, states, "When these relations shall be known, all physical phenomena will be a branch of pure mathematics." What are physical phenomena? Trace a minute cell in its ever-varying and minute alterations of form, watch that cell altering into cells

what experiments confirm. Preconceived ideas, subjected to the severe control of experimentation, are the vivifying flame of scientific observation, whilst fixed ideas are its danger. Do you remember the fine saying of Bossuet? 'The greatest sign of an ill-regulated mind is to believe things because you wish them to be so.' To choose a road, to stop habitually and to ask whether you have not gone astray, that is the true method."—("Louis Pasteur, His Life and Labours," 1885, p. 219.)

[1] The italics are ours.

of the most complex order, and the secretions of those cells. These are some of the common physical phenomena. How is it possible for the science of mathematics to enter upon such reactions? The line between the inorganic and the organic has ceased. It was a delusion. And the physicist would interpret the complex phenomena in nature by variations to the x power, by angles, by sines, and co-sines, and all these rigid formulæ. What a grave error! Nature abhors the rigid.

Other beings equally intelligent as the physicist see the folly of attempting to explain Natural phenomena by these rigid lines, but the physicist is aggressive, so much so as to call for the following protest from Professor W. A. Herdman, in his Presidential Address (Zoological Section) at the same British Association meeting, Ipswich:—"I must emphatically protest against the idea which has been suggested, that only by such mathematical and statistical methods of study can we successfully determine the influence of the environment on species, gauge the utility of specific characters, and throw further light upon the origin of species."

But the physicist must clearly see that his rigid system cannot apply. Professor Hicks, in his address, states, "Unfortunately the mathematical difficulties connected with the discussion of these motions, especially the reactions of one on another,[1] have

[1] No doubt minute objects—atoms, and molecules, react upon each other according to definite laws, but when it is attempted to mathematically measure these motions, the effort is obviously futile, impossible. This is the more certain when it is found impossible to do so with only three objects. (See page 47.) When we consider

retarded the full development of the theory." The fact is, mathematics cannot solve the problem, because the motions of molecules are ever varied—infinite. And so the result of the remarkable address of Professor Hicks is summed up in these words, "These, however, are perhaps rather vague speculations. . . The rapid survey I have attempted to make is no doubt a medley of suppositions and inferences combined with some sound deductions." [1]

Therefore, the obvious conclusion is, *the layman and the mathematician are on equal platforms.*

It does not require a mind educated in the rigid to solve these important problems. Such an education absolutely debars the mind from grasping the elastic and wonderful phenomena in Nature, and we venture to assert that minds educated by viewing and studying the minute by means of the microscope, have an infinitely superior chance to those minds which study mathematical ratios and equations, and especially geometrical formulæ, and which minds are mostly ignorant of the progress of microscopical science.

We are absolutely compelled to treat the case in the way we are doing, because the general public is so indoctrinated with the idea that good can only come from departmental labour, and because physicists will only be guided by the rigid reasoning of their department. While acknowledging the valuable, very

the (to our minds) innumerable number of water molecules of which the ocean consists, each having an ever-varied motion, the act of mathematically measuring these motions must most certainly fail.

[1] Prof. A. R. Forsyth's address to the same section at Toronto, 1897, is of entirely a different character to Prof. Hicks' address. It is quite apologetic for mathematics!

valuable, successes of the physicist in commercial matters, we venture to assert that there are ideas, true ideas even, which are beyond his ken. And the public should study and grasp these ideas which transcend the mind of the physicist, for the physicist has got into a fossilized condition; he will not move until that rising power—general intelligence—forces him.

We are now ripe to consider the all-important fundamental problems: What are the forms of atoms and how are their initial functions exercised? This is the starting-point, this is really the foundation of all knowledge. The grasping of these initial ideas is the basis of understanding all religious, all political, all social questions—in fact, to understand "*Our Life.*" How important, then, it is that we should endeavour to grasp these fundamental problems!

Now, we venture to assert that experiment in the most overwhelming and conclusive way proves the following: the formula of formulæ:—

First, the atom and the molecule are not rigid objects. They expand and contract *per se* by the absorption or rejection of an *antigravitating* fluid, which is atomic and may be called Ether or any other name.

Secondly, that at a certain increased volume or dimensions (called temperature) of atoms or molecules, they over-wrap each other,[1] and when the volume of the new object—the molecule—is less than the sum of the volumes of the combining objects, then Ether becomes free. This free Ether operates upon surrounding matter, which increases in temperature; then Ether radiates *from* the newly-formed molecule. This is the first factor of Energy, and one source of the flow of

[1] See the author's work, "What is Heat?" § 104.

Electricity—Electricity is the motion of Ether. If the process is inverse, then Ether radiates or travels *to* the atoms or molecules, the result of the so-called chemical reaction.

Thirdly, Ether is ever-present. It is always in motion. Its atoms are rigid.

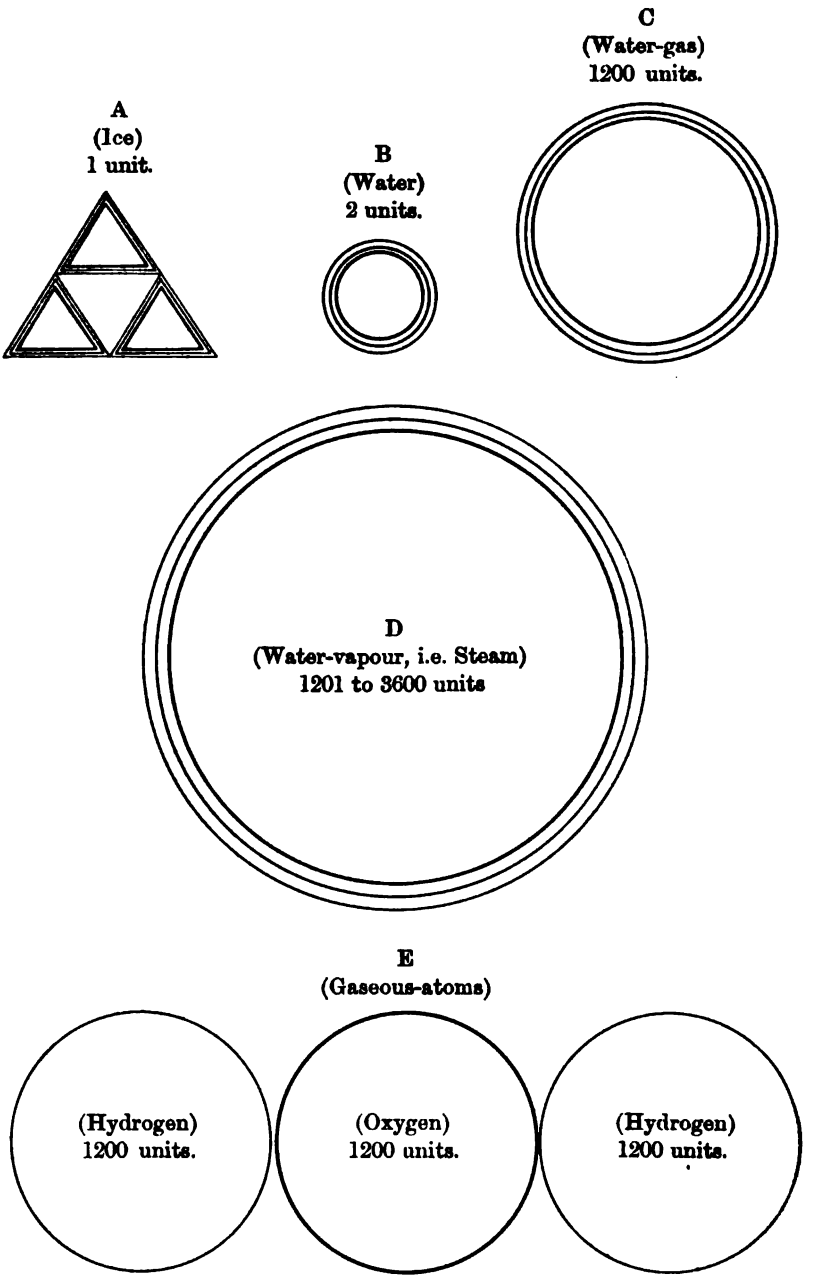
The diagram fig. 5 illustrates the various reactions, atomic or molecular, matter passes through. It must be remembered that in the formula here given, no attempt is made to give *real* numbers of atoms of Ether, nor the motion of Ether, which operates upon the atom or molecule.[1] It is best to fix the mind upon one specific species of molecule. We select the water molecule. Now, we venture to assert that experiments clearly show the following to be the fact.

We must recollect that we are dealing in the illustration with vastly minute objects—water molecules, and the fluid Ether. This fluid we have shown can be seen in mass by the naked eye,[2] and its antigravitating power demonstrated.

Fig. A shows the molecules in the crystalline form—three molecules are shown. It is not pretended that the crystal is of the form represented. The illustration only means to convey the idea that the molecule is not spherical. In this condition the molecule is built up of three objects, two of which are inside the third—three atoms—two hydrogen atoms and one oxygen atom. It also has in its interior, say, one unit of Ether. What the unit represents we do not know, and probably will never know. This is the most dense condition of water

[1] This latter is fully explained in the author's work, "What is Heat?"

[2] See "What is Heat?" page 142.



*One volume of water equals 1800 volumes of vapour (steam) and of oxygen and hydrogen gases.**

Fig. 5.—The figures represent in sections the various well marked but not rigid forms a water molecule assumes.

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* See note 1, p. 55.

which exists on this earth, and the molecules cohere together and form a solid mass—we call it ice.[2]

Fig. B shows the molecule further expanded, its volume is greater, that is, its *temperature* has increased. By the absorption of Ether it has ceased to be angular —it contains two units of Ether. It is now a spherical object moving freely amongst other like objects. So minute is it that probably our instruments will never permit this object to be seen; but we can see a mass of these molecules and we call it water. Now the absorption of Ether from the crystal to the liquid can be proven by experiment.

Fig. C shows a further increase in dimensions by a further absorption of Ether from two units to 1,200 units. And then we have the gaseous molecule. The motion, in mass, of these molecules is easily *seen* in the "singing water-hammer." [3]

Fig. D shows an object which has absorbed a still further increase of Ether, say from 1,201 units to 3,600

[1] (See Fig. 5.) "When, by boiling under the atmospheric pressure, water changes into steam, it expands 1,800 times; or, in other words, one cubic inch of water yields one cubic foot of steam, nearly." —("The New Chemistry," Prof. J. P. Cooke, LL.D., 1892, p. 6.) "The wonder becomes still greater when we learn that water yields 1,800 times its volume of the two gases, and that these gases retain their aëriform condition so persistently that mechanical pressure alone cannot reduce them to the liquid condition."—(*Idem*, p. 114.) "In the union of the two gases to liquid water, a condensation of 1,800 times takes place, so that, in order to obtain a quart of liquid water, we must burn 1,200 quarts of hydrogen gas, and take from the air 600 quarts of pure oxygen."—(*Idem*, p. 218.)

[2] See "What is Heat?" § 180, which also explains why ice is specifically lighter than the molecules on which it floats. All the reactions are explained in simple and clear language so that the layman can understand.

[3] *Idem*, p. 324.

units of Ether. The quantity of Ether depends upon external conditions, especially atmospheric pressure; and all over the dimensions of fig. C we call vapour, but when it approaches the capacity of, say, 3,600 units we call it in the mass, steam. Now this object can be seen by the naked eye, and it is an intensely interesting object under the microscope.[1] When we search for a thing and we find Nature shows us that thing; when the condition of that thing follows an absolutely harmonious line of thought, and brings all Natural phenomena into one order—one harmonious whole, it is impossible to get away from the idea that that thing exists.[2]

When Ether is still further forced upon this water molecule, that is, when the molecule holds more than 3,600 units, then these atomic objects unwrap themselves, divide a portion of the Ether amongst themselves—each takes, say, more than 1,200 units of Ether. This overwrapping, forces upon us the conception that each atom and molecule has polar openings by which, if we may use such an expression, they swallow each other.[3] The excess of Ether of over 1,200 units radiates through matter, generally through the air until the atoms become of the temperature of the air, then each of the gaseous

[1] *Idem*, p. 265.

[2] "The ultimate aim of pure science is to be able to explain the most complicated phenomena of nature as flowing by the fewest possible laws from the simplest fundamental data."—(Professor W. M. Hicks' Address, British Association Meeting, Mathematical and Physical Section, Ipswich, 1895.)

[3] "In a certain sense the iron may be said to eat the oxygen, reject the hydrogen, and grow or increase in weight by what it feeds on; but the result is not a bigger piece of iron, but a new substance, rust, or oxide of iron."—("A Modern Zoroastrian," S. Laing, 1895, p. 81.)

objects (oxygen and hydrogen atoms) holds 1,200 units, and this is the reaction which we obtain when we submit steam to a high temperature, or water molecules to electrolysis. We see therefore that the three gaseous objects which composed the water molecule ultimately are objects of the same volume, approximately, as water in the gaseous form (fig. C), and of the same volume or dimensions as the molecules of which the air consists. This explains the law known as Avogadro's Law in chemistry and physics. It is like most things in Nature, not a rigid law, only an approximately rigid law.

Let us grasp the conception of the inverse process. To the three atoms in fig. E an excess of Ether is forced, and they wrap over each other and become concentric, forming a molecule of steam, fig. D. Immediately after the forming of the molecule, or, as the chemist calls it, combination takes place, it vibrates. Not a vibration of impact and recoil, like solid, rigid billiard balls hitting each other, but an alternate, very rapid, and a very small contraction and expansion of the molecule, *per se*, takes place. This vibration of the molecule lasts but a very short time. This is the molecule in the incandescent condition, and when we see these vibrating molecules in mass, we call the mass flame. It is possible to illuminate steam in such a way that it looks so completely like flame that even the expert, if he did not know the condition of the experiment, would be most positive that that which he saw was flame.

When the expanded water molecule fig. D is formed, it almost immediately begins to contract and exude Ether very rapidly, even faster than gaseous matter can absorb it, and Ether becomes for a time free or intermolecular. It is this free Ether which lights a

match or a piece of wood over an argand chimney, although it is a considerable distance from the flame. Under these conditions both the steam and the free Ether are invisible, but it is easy to make these visible and to sift out the free Ether from the steam.[1] It is not only possible to see the free Ether in air, but also in water.[2]

Now this diagram shows the fundamental reactions in what is called inorganic matter, that is, matter which is non-cellular. It is a simple diagram, which shows all but one inconstant phase. Not all molecules alter to the crystalline when they become solid.* There is no rigid line. The change of state from the liquid to the gaseous can be seen by the microscope, more, even seen by the naked eye.[3] During the period figure B expands to figure C, that is, when the liquid water molecules expand to gaseous water molecules, the absorption of Ether can be shown by experiment.[4] Everyone knows that if we have a measure of spherical seeds, and we carefully shake that measure, the seeds pack themselves closer together—they occupy a smaller volume. Now in the singing water-hammer the water molecules can be packed together in the same manner as the seeds in mass. When this is done the cohesion is such that the liquid gives all the effects of a rigid body, and the water molecules refuse to obey the law of gravitation. The loose condition of water molecules can be seen also.[5]

The diagram must not be regarded as rigid, the size (i.e. the temperature) of both gaseous and vaporous

[1] See "What is Heat?" pp. 197, 252. [2] *Idem*, p. 261.
[3] *Idem*, p. 287. [4] *Idem*, p. 289. [5] *Idem*, p. 323.

* See "Proceedings of the Royal Institution of Great Britain," vol. xiv., No. 88, 1895, p. 397, on Scientific Uses of Liquid Air, by Prof. Dewar, F.R.S.

molecules alter according to the pressure of the air. All atoms and molecules, except in the solid, are in perpetual relative motion—heterogeneous motion. They are in contact as seeds or shots are when in a vessel or nearly so.[1]

[1] It is most remarkable how experiment shows that the formula illustrated by the diagram is true. Thus, two volumes of hydrogen gas at 100° C. combine with one volume of oxygen gas at 100° C. to give two volumes of dry steam at 100° C. But in order to obtain this result the oxygen and hydrogen atoms must be expanded from the condition they exist in at ordinary temperature, as illustrated in the diagram fig. 5. Let us say fig. E illustrates gaseous atoms at 15° C. They are increased in dimensions or volume, or we may call it "atomic temperature," until we obtain a ratio of 100° C., as measured by the mercurial thermometer. When at this volume or molecular temperature, chemical combination takes place, and this can be effected by the electric spark; the atoms of oxygen and hydrogen then wrap over each other, and a molecule of water of the dimensions of fig. D is the result. We call it a molecule of steam. Now suppose, for a moment, our figures are actually correct, then three objects expand by absorbing Ether to hold each say 1,800 units of Ether, this reaction is what the chemist and the physicist call raising the temperature of the gases to 100° C. When chemical reaction has taken place, the three atoms holding collectively 5,400 units of Ether become one molecule of water in the form of steam holding 3,600 units of Ether (fig. D), and the difference, 1,800 units of Ether, become free. It is this Ether which raises the temperature of bodies when we submit them to what is called flame. Moreover the object, fig. D, can only continue to exist as a molecule of steam by supplying a constant current of Ether to it, or, as it is called, keeping the steam hot, for if this is not done, it immediately contracts to the temperature of the air, i.e. to the dimensions of figs. B or C, in other words the molecules become liquid or gaseous, and as the molecules contract they give out Ether to the air and raise the temperature of the air. This is the secret of heating rooms by steam or hot water.

The process can perhaps be better grasped if we picture to the mind that each atom in fig. E acts like a very minute india-rubber balloon which expands by internal pressure, as when air is forced into it; only

Now we have seen the phases of one class of molecules, namely water molecules. Every species of molecular matter—and all matter is atomic or molecular—has like phases, but differs according to the inherent properties of the special class of matter.

1st. Each species of matter has its specific zero atomic or molecular dimensions or volume, called temperature in the mass.

2nd. Each species of atomic or molecular matter has its specific acceleration of absorption of Ether—that is, when Ether is presented to the molecules they get, as it is called, hotter and hotter, or higher and higher in temperature, or larger and larger in dimensions, according to their *inherent* capacities or powers.

3rd. Each species of atomic or molecular matter has its specific rate of acceleration—that is, some molecular matter in mass picks up Ether more quickly than other molecular matter.

It will follow from the above formula that every class of matter (i.e. atoms and molecules in mass) has its specific temperature, called by the specialist "heat of condition," and these temperatures are always different according to climate. This can be proved by experiment.[1]

we are not dealing with air but with a fluid called Ether. Call the internal pressure "strain," then the strain is acting against a "stress" which is inherent in the balloon—always tending to contract. In fig. E we have one stress for each atom, while in fig. D we have three stresses to a similar strain. It is this increase of the power of stress which causes the water molecule in the vaporous form to contract to the liquid form, giving out Ether as it does so.—(See "Watts' Manual of Inorganic Chemistry," 1889, p. 65, Dr. Hofman's experiment; and the author's work "What is Heat?" where the whole of the reactions are explained by a great many experiments.)

[1] See "What is Heat?" p. 294.

Now let us see how completely this formula covers all the facts.

The gaseous molecule is, or tends to be, a spheroidal object and has a free motion in mass.

The liquid molecule is a spherical object and has also a free motion in mass.

Thus in the case of water the three gaseous atoms (spheres) unite by overwrapping to form *one* molecule (a sphere).

The human mind is only able to grasp this *one* conception to account for three spheres becoming *one* sphere. And the scientific world, as well as our "common sense," can only understand the motions of fluid molecules (that is, in our illustration, liquid or gaseous molecules) by the molecules being spheres.[1]

Press gases together with any amount of pressure and submit them to great cold, they will become liquid, but they will never combine. The diagram explains that, in order to allow chemical combination, atoms and molecules must expand in order to overwrap.[2]

Professor Dewar has liquefied oxygen gas and the gases of which the air is composed. These liquids have such an affinity for Ether that when they are quickly evaporated to the gaseous condition the vessel holding the liquid becomes so cold, that the gaseous molecules of which the air consists give up their Ether to the outside of the vessel, which in turn gives up Ether to the liquid oxygen or air, in order to permit the liquid molecules to become gaseous again, and so the free gaseous air molecules collected on the outside of the receiver

[1] See "What is Heat?" § 97 and § 98.

[2] For the full illustration of the mode of overwrapping, see the author's work "What is Heat?" It is impossible to give the details in this book.

become liquid molecules—liquid air. Thus pressure, at least an excess over the atmospheric pressure, is not necessary to liquefy gases. Only deprive the gaseous molecules of Ether, they pass into the liquid condition and further deprive the liquid molecules of Ether, then they become the solid molecules: illustration—ice. Although oxygen and nitrogen, the main constituents of the air, are known by chemists to combine in five proportions, in the case of liquid air there is *no combination*.[1] The molecules forming liquid air are all free, and when evaporation takes place the nitrogen molecules absorb Ether first and spring into the gaseous form, followed by the residuum— the oxygen molecules. Experiment proves this. This shows a selective power for Ether, or it may thus be expressed: *There is a law of the strongest amongst molecules in seizing Ether.**

Now, although our diagram illustrates only one species of molecule of three atoms or multiples of three, which assumes different specific forms, combinations of the same order, perhaps of hundreds of atoms overwrapping each other *and always in definite succession*, may exist to produce a definite compound, *a molecule*, even AN ORGANIC MOLECULE. In one order of combination or configuration the molecule may be a poison, in another order consisting of the same number of atoms an antidote.[2] Hence the chemist's conception

[1] When a strong alternating current is passed through air – from the two electrodes there is seen a flame—the result of combining oxygen and nitrogen. A gas is thus formed, of which little is known at present.

[2] "Enough has been said to show that proteids are also protean, and that they may offer many kinds of opportunities 'for different kinds of chemical intercourse.' One kind of proteid may be nutrient, another may be poisonous, another may be protective from further

* See Appendix, p. 287.

of "isomerism." Moreover, as there is an order of overwrapping, the outside envelope must always come off first. And when this has come off, we have left what the chemist, upon the present theory, calls a radical molecule or residue. Still more, the order of overwrapping is what forms organic compounds, and to form these compounds they must be combined in their natural order of overwrapping. Now we see how arises the first living molecule—the organic molecule—the molecule of protoplasm.

When molecules are formed by *absorbing* Ether the compounds are called by the chemist *Endothermous*. When they let Ether free they are called *Exothermous*. Thus these words only explain a very simple fundamental idea.[1]

infection; the same proteid (albumose) that nourishes the body if it enters and is modified by the intestinal epithelium, fails to nourish a tissue with which it comes into immediate contact . . . and proves actually poisonous when directly injected into the blood-vessels."—("An Introduction to Human Physiology," A. D. Waller, M.D., F.R.S., 1896, p. 189.)

[1] Mr. Laing has admirably summed up orthodox views of the elements in the universe in the following words:—

"We are now able to realise what are the ultimate elements of the material universe, and it remains to show how they are put together. The elements are ether, energy, and matter.

"First, ether: a universal, all-pervading medium, imponderable or infinitely light, and almost infinitely elastic, in which all matter, from suns and planets down to molecules and atoms, float as in a boundless ocean, and whose tremors or vibrations, propagated as waves, transport the different forms of energy, light, heat, and electricity, across space.

"Secondly, energy: a primitive, indestructible something, which causes motion and manifests itself under its many diversified forms, such as gravity, mechanical work, molecular and atomic forces, light, heat, electricity, and magnetism, all of which are merely Protean

Moreover, however complex the molecule may be, it always is capable of assuming the forms in the diagram (assuming fig. A to convey the idea that in many cases they are non-spherical); but the quantity of Ether absorbed, in order to produce decomposition (i.e. unwrapping of the molecule), is a specific quantity of Ether for each species of molecule.

Professor Dewar finds that liquid oxygen in contact with certain compounds—molecules, having great affinity for this element at normal temperature, that is, in the gaseous condition—will not combine with these molecules when at a very low temperature or volume, and if our diagram is true, we now know why.

A lucifer match frozen at a very low temperature will not ignite by friction, but directly it is warmed it will then ignite.

It is very interesting to view an object surcharged with Ether, and see the Ether *ascending* from that object, and the *ascending* motion of the gaseous molecules, which have received this antigravitating fluid, and this fact absolutely gets rid of one of the greatest difficulties existing in the minds of physicists, namely:

transformations of the one fundamental energy, and convertible into each other.

"Thirdly, matter: the ultimate elements of this are atoms, which combined form molecules, or little pieces of ordinary matter with all its qualities, which are the bricks used in building all the varied structures of the organic and inorganic worlds."—("A Modern Zoroastrian," S. Laing, 1895, p. 66.)

Mr. Laing, however, does not perceive that the "medium" Ether is an antigravitating fluid, nor does he understand the most important reaction, under the influence of Ether, of the mode by which atoms combine to form molecules. Still, he states "received or orthodox views" very concisely and clearly.

All molecular matter loses density in proportion to the Ether absorbed.[1]

We have now our initial conception of the fundamental natural condition of things. *The fundamental power of the atom and molecule is inherent and eternal* —the power is made active by Ether—Ether is ever present. ALL NATURE IS ALIVE. What a grand view of Nature compared with the narrow view of metaphysical ideas! And how wonderful that a great group of

[1] All these facts are experimentally illustrated in the author's work, "What is Heat?"

It is also very interesting and instructive to watch the conversion of the crystalline molecule into the liquid molecule by the absorption of Ether. The experiment is very simple. Take a glass of nearly boiling water; drop a piece of loaf sugar into it—the sugar falls to the bottom of the glass; and if it is put in a suitable light the crystalline molecules can be seen, in mass, to become spherical and to *roll down* to the bottom of the glass. Each liquid sugar molecule is denser than the water molecules. Carefully set the glass aside without shaking its contents. After a day or two, taste the water. No sweetness can be detected. The dense sugar molecules, still in a liquid condition, remain at the bottom of the glass, invisible. Now stir the water and the sugar molecules can be seen, in mass, mixing themselves with the water molecules, just as we can mix small spheres between larger ones, as, say, small spherical seeds between glass marbles. If now the water is tasted, it is sweet. And this is why we stir our tea after we have put the sugar in.

Also another extremely simple experiment explains the diagram. Half fill a tumbler with cold water, cut a piece of cardboard to float on and cover the surface of the water. Now get some hot water and very gently pour it on the cardboard. The latter will rise to the surface of the hot water, and as it does so it breaks the force of the fall of the hot water and thus prevents the latter from mixing with the cold. Let the card be carefully removed. *The hot water will remain on the top of the cold water and will not mix until it has become the temperature of the cold water below.*

ever-changing living molecules,[1] called the human being, can be so constituted as to be able to produce instruments invented by many minds, which prove the above formula of formulæ—that it is true.[2]

[1] "A proteid molecule is very large, and composed of a large number of atoms of C. O. H. N.; these may 'hold hands' so to speak, in many different ways; the molecule, while forming part of protoplasm, may take many shapes, may offer many kinds of opportunities for different kinds of chemical intercourse. It is to this character that the proteid molecule owes its preponderating importance in living matter; the molecule, while in living matter, is 'all alive' the seat and centre of an active commerce of atoms."—("An Introduction to Human Physiology," A. D. Waller, M.D., F.R.S., 1896, p. 6.)

[2] This has been the experimental effort of the author in his work, "What is Heat?" Nature never disappoints the formula; at least, that is the author's experience.

STATEMENT No. 10.

The number of species of atoms is unknown, it is most likely an enormous number. We probably know about seventy of these species at present.

When the chemist finds a species of matter which resists all the agencies known to him, for splitting up that matter into two (or more) kinds, differing from the original mass, then he calls that species an "element." And from its behaviour of combining and re-combining with other matter, he is obliged to regard the mass as consisting of individual objects—atoms or molecules. It is not at all necessary for us to go into the details of chemistry—this is the business of the chemist. All we have to grasp is: that in order to account for the various combinations in Nature, the atoms must have the power to form endless (that is, to our minds endless) combinations, called molecules, and to account for the facts this power is an inherent and eternal one. It is quite possible, we think we may even say probable, that some of the so-called elements may prove to be compounds.

What right have we to imagine even that the number of species is seventy or thereabouts? Science is constantly finding new species or elements. How

can the chemist possibly detect the rarer elements? He takes masses of matter—a great unknown number (the mathematical x) of molecules, and submits them to his various processes of analysis in order to obtain what he calls chemical elements. Naturally, in the course of things the chemist would most readily discover the more plentiful of the elements, but the rarer would elude his observation. His mode of procedure is always the following. For the sake of simplification, instead of dealing with oxygen, hydrogen, and so forth, we will call the elementary species after the letters of the alphabet. Let us regard a mass of molecules consisting of three elements, say A, B, C. They are in chemical combination, or, as the chemist calls them, "bonded together." A very convenient term, but the chemist does not understand what "bonding" means. Under a certain temperature the chemist puts another element, say D, to the combination, and Nature, *not the chemist*, performs a reaction. C from its inherent and eternal powers bonds itself with D in preference to his previous associates A, B. What is the consequence? The chemist finds, strictly in harmony with the forces in Nature, and *no other*, that he is in possession of the groups of molecular matter called A, B and C, D. Having succeeded thus far, his object is to isolate A from B. He presents another element, say E (or it may be a compound—a mass of molecules), to the combination A, B. And B, strictly in accordance with, and only with its inherent—eternal powers, elects to associate itself with E in preference to its old companion A. A being the *weakest in combining*, is left isolated, and if the chemist can find no class of atoms or

molecules to further divide A, he calls it an "element." This is the fundamental mode of procedure adopted by the chemist. He calls the reactions "chemical reactions" according to chemical laws. But the fundamental idea is radically false. It arises from the excessive division of labour. There are no laws of chemistry; chemistry is not a god; there are laws of Nature only. We must not look at Nature from a departmental point of view. Chemical reactions in all their phases, in every motion of every object, atom or molecule, and in every form of the mass, are part of one huge cosmos—Nature.

Or the combination may consist of molecules, say, A, B and C, all free, moving amongst each other. It is a liquid, and the chemist submits the compound fluid to a certain definite temperature, and one of the constituents, say molecules called C, seizes the antigravitating Ether more quickly than A and B. They rise in the air, or in the worm of a distilling apparatus, and by this process we have C separated from A and B. C may be a compound or an element, that is, molecular or atomic. This is a second mode of procedure called dissociation, but it is not generally so perfect as chemical reaction or bonding by molecules. Because our evidence [1] clearly shows, besides the reaction caused by the molecules expanding by the absorption of the antigravitating Ether, certain of the molecules of A and B are mechanically buoyed up and carried upwards by the ascending and expanding molecules. Or, inasmuch as all chemical reactions are dependent on Ether, and this is a natural law, we may force a current

[1] See "What is Heat?" p. 265.

of Ether, called an electric current, *through* molecules, and they may be decomposed into elements, as in the case of electrolysis of water, where the Ether is divided partly for the freedom of oxygen atoms, and partly for the freedom of hydrogen atoms.

Again, we may take from the fluid the pressure of the atmosphere, and certain molecules will rise from the surface, and become gaseous; or we may divide gases by passing them through minute tubes and membranes. These are the principal modes of procedure adopted by the chemist. He only succeeds when he is in harmony with the Natural laws.

Now a moment's reflection will show, that with all these processes the chemist can never succeed in a pure separation of molecules or atoms. He can only deal with masses; he cannot take atoms or molecules one by one with his fingers and sort them. If his process be what he calls "chemical reaction," he will always have an excess of something in his mass. If his process be distillation, there will be always some molecules carried away mechanically in distillation, and so also there will be with his tubes and membranes. And although a great perfection may be and has been arrived at, the results are only near, very near approximations.

Moreover, if elementary matter exists in sparse proportions, say, for illustration, one unknown elementary atom is in the order of things mixed with a million, a million billions—a stupendous unknown number—of other atoms and molecules, what possible chance has the chemist of finding by his processes, that one atom? Only could this be done if the chemist could

handpick away from the mass all the known from the unknown.

And more than this, suppose there is elementary matter of such a character as will *only* combine with molecules of a very high complexity, that is to say, atoms which form highly complex molecules, such an order as X, an atomic element having the power of combining with the residuum letters of the alphabet, each letter representing the name of an element, how would it be possible for a chemist to detect the existence of such an atom? Such powers are beyond the chemist, but Nature makes such combinations, and these we see in what is called organic matter—the basis of Life. Atoms which are sparingly distributed cannot be collected in mass by the chemist in quantity. Now suppose in the natural order of things, that matter consists of (to our minds) an infinite number of species of atoms, and that the greater part or number of species are sparingly distributed in matter, let us say, for example, one per cent.[1] of the molecules of which the air consists. Well, all the chemist or physicist has to do is to combine very carefully the oxygen, nitrogen, carbonic acid and other *known* molecular materials of which the air consists, and having combined these and abstracted them from the air, and having carefully filtered, either before or after the process, all germs and foreign matter floating in the air—then he will have in his possession the residuum; a mass, say, of thousands or millions of species of atoms, each of which has its specific combining

[1] From the nature of Lord Rayleigh's experiment producing Argon, it is probable that the percentage of Argon to Air is much greater than one per cent.

power—a combining power of a very high order—a combination which is termed organic.[1] Such a residual mixture we may call "Argon," but we must not regard it as an element.[2] Now what would be the consequence of such a condition of things? The chemist or physicist would never be able to cause this *mixed* atomic matter, which he calls "Argon," to combine with any other element,[3] because each species of the elements of which these gases in mass consist, called Argon, has its special complex combining properties, and as there may be, and probably are, millions of these different species of atoms —then if our deduction is true, the artificial combination of Argon is impossible. The chemist could succeed if he could isolate one atom of these very rare elements, and could collect together a mass of other

[1] "The essential constituent of each digestive fluid is a *ferment-ptyalin* in saliva, *pepsin* in gastric juice, *trypsin* in pancreatic juice, *invertin* in intestinal juice. These and other ferments are the specific agents by which the digestive transformations of food are effected. They are the occult agents of modern physiology, inasmuch as they have never been isolated as definite bodies, and are recognized to be present only by the effects they produce. They are not confined to animals, but are also found in plants."—("An Introduction to Human Physiology," A. D. Waller, M.D., F.R.S., 1896, p. 162.)

We thus see what an immense field of research is open to the chemist. Is it not a field so vast as to be beyond the human power to investigate, in order to isolate such complex factors?

[2] Prof. Ramsay has now proved that "Argon" is not an elementary gas, for he finds it contains six distinctly different gases which he calls "neon," "krypton," "xenon," "metargon," and "helium."—*Nature*, Jan. 26th, 1899.

[3] Prof. William Ramsay's Address to the Chemical Section, British Association, Toronto, 1897, entirely confirms the Author's views.

elements, bringing them together one by one in *their order of combination* and under a suitable temperature; they would then wrap over each other and form a molecule of great complexity. Now Nature does what man cannot do, and when Nature does this act we call it "spontaneous generation." We shall presently see to what important issues this fundamental conception leads us.

STATEMENT No. 11.

The fundamental factor in the formation of molecules, under the influence of Ether, is the selective and combining power of the strongest species of atoms.

THE following experiment is very suggestive. We take a magnet and present to it a piece of nickel. It seizes the nickel, which adheres to it. Now we present to the magnet a piece of iron, and then the magnet seizes the iron, holds it, and drops the nickel. And it will not again take up the nickel until the iron is removed. The steel magnet consists of minute objects—atoms; the iron is the same, and so is the nickel. It must follow, that under normal atmospheric conditions steel atoms when magnetic have a greater selective power or grip over iron than over nickel. Of course, in this case the steel or nickel will not be pure, therefore they are not solely atomic, but other molecules are mixed with the atoms. We must keep in mind that probably all substances are magnetic, although in a very slight degree.[1]

Now this experiment illustrates what we have just explained as the selective power of atoms, only it differs from our previous illustrations in the fact that there is no chemical combination. It is interesting to

[1] "Modern Views of Electricity," Prof. O. J. Lodge, F.R.S., &c., 1892, p. 314.

know that there is also this selective power without chemical combination.

It would follow that if this law of the strongest were supreme in atomic matter, Nature would ultimately get into a rigid condition.

Now comes in the wonderful factor of Ether. Without Ether no combination: a certain pressure or "strain"[1] of Ether on atoms causes them to combine, a greater pressure causes them to decompose. And thus Nature compels a constant change by the power of the factor of factors—Ether.

One illustration may suffice. "Pure mercury is quite unalterable in the air at common temperatures, but when heated[2] to near its boiling point, it slowly absorbs oxygen, and becomes converted into a crystalline dark-red powder, which is the highest oxide. At a dull red heat this oxide is again decomposed into its constituents."[3]

That matter has an influence over matter, even at a distance, the following important experiment proves.

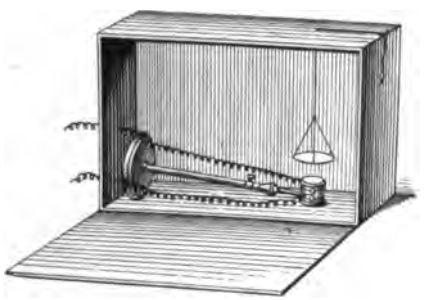

Fig. 6.—Thermopile with object acting upon it at a distance.

[1] See "What is Heat?" for definitions of "stress" and "strain," p. 120.

[2] *Idem*, for definition of "heated," p. 125. [3] *Idem*, p. 341.

A thermopile is placed in a *dry* wooden box the outside of which is white-washed, so that when closed external influence, say from the human body, shall be reduced to a minimum. Suspended by means of a fine white silk thread passing through the top is an object. Any matter appears to answer; a thin disk of ebonite, as illustrated, gives very marked results. The object is suspended a quarter of an inch above the thermopile. It may rest there an indefinite time. The thermopile is connected with a sensitive galvanometer. Now experiment proves that this suspended object is always acting at a distance upon the thermopile; moreover, if we pull up the object, say two inches further from the thermopile, the object is acting on it with greater intensity than when it is closer. Remember the box is closed, and thus the experiment is performed in the dark.[1]

[1] The understanding of the fundamental principle of this remarkable experiment may be conveyed to the mind in the following way. A piece of copper wire is twisted round a piece of iron wire—the same as a bell-hanger does. From this "couple" is connected a length of insulated copper wire made in a coil at the further end. A light magnet is suspended in the centre of the coil by means of

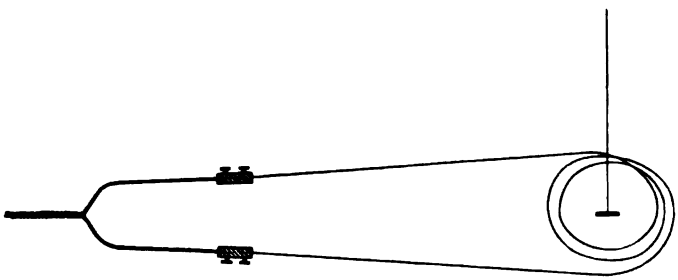

Fig. 7.

a fine thread of unspun silk—*there is no contact between the magnet and the coil.*

The magnet moves round like a magnet of a compass. Before

To sum up then: All matter is atomic. There is an indefinite number of species of atoms. Atoms combine to form molecules (that is, they wrap over each other), but only under the influence of Ether; as also under the influence of Ether do they become dissociated and resolved into their constituents or else into new combinations. Atoms and molecules having different grades of affinities or potentialities, there is a law of the strongest in the formation of molecules under the influence of Ether—ALL NATURE IS ALIVE.

connection is made, the magnet pointed due north and south. Now when an object, whatever it may be, is held a small distance from the junction (or junctions as illustrated in the experiment fig. 6) that is where the copper is twisted round the iron, then a deflection (as the movement of the magnet is called) takes place, while if the object is removed still further away from the junction (within certain limits), the deflection is increased.

When such a metallic combination or "couple," as it is called, is made with certain metals, and is otherwise increased in the number of junctions, it becomes what is called a "thermopile," and when the magnet by a special arrangement is made more sensitive in its movements from the north and south directions, and is inserted in a similar coil of wire, it becomes what is termed a "galvanometer."

Of course the instruments used in these experiments must be very sensitive, otherwise the reaction is not obtained. The above is merely to show the principle of the experiment.*

* For a full description of the thermopile and the galvanometer see "What is Heat?" § 61.

STATEMENT No. 12.

From the combining power of the strongest species of atoms under the influence of Ether, arises the formation of cells.

GIVEN the power of certain atoms to dominate and thereby group together other atoms, we obtain certain fundamental molecules acting on groups of molecules, causing them to cohere and form a colony—a whole: such dominant molecules become thereby *centres of force*. Now we come to a very remarkable piece of evidence. We have shown that all nature is alive. A cell is a unit mass of living matter. Every cell can only be regarded as a minute individual built up of living molecules. All molecules are built up of living atoms. Cells generally have a denser superficial layer or envelope, which we may call a cell-envelope or cell-wall, which is built up of special molecules, thus: Each molecule

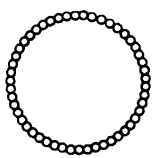

Fig. 8.—Diagram illustrating the formation of a cell-envelope by molecules adhering to each other. The diagram shows a section of a sphere, the contents of which are free, moving molecules, that is, molecules in a liquid or viscid condition.

touching the next molecule with a certain definite cohesion, a condition exists between the liquid and solid.

Cells are plastic. It is not pretended that the envelope consists of only one layer of molecules. We can never exactly solve the problem of the arrangement of the individual molecules, because, as we have stated, the molecule in the solid or liquid condition is an object so minute as to be beyond the highest powers of the most observant eye or even the most powerful microscope. This cell-envelope may be of any conceivable form, except the rigid forms found in geometrical science. Nature abhors the rigid. But the typical form of the cell may be taken as more or less spheroidal. Inside this envelope is a living substance, called by the specialist *protoplasm*, and inside this there is seen, generally in the centre of the mass, an object which specialists call a *nucleus*. This object varies in structure from time to time. Inside this nucleus there are now recognized structures of bewildering complexity, and there may appear yet another object, which is called by the specialist a *nucleolus*. We need not let the mind rest on these technical terms. What we want to do is to grasp the fact.

There is no hard and fast line in the structure of these minute individuals. But we are now going to draw attention to this important fact, that the centre of force would appear to be in the central object – the nucleolus. This nucleolus is a highly organized complex object. Now we have demonstrated the selective capacity of atomic matter. Regard this centre, the nucleolus, as consisting of a mass of molecules (each of which is a huge compound of atoms), molecules of unlike nature, grouped together; and carry the mind one step further, this grouping is formed and controlled by one molecule, which molecule is formed and controlled *by one atom*.

Let us consider this, for the sake of making our ideas clear, the centre atom in our diagrams (fig. 5 A to D), then we have the initial fundamental idea of Life.

We will now consider the evidence of the specialist. Professor E. A. Schäfer states,[1] "All are aware that the body of every animal and of every plant is made up of minute corpuscles[2] which are formed of protoplasm, and which contain in every case at least one nucleus. The protoplasm and the nucleus form the living substance of the cell. Other substances may be present, but they are, in a sense, outside the nucleus and protoplasm, not incorporated with their substance. Apart from a few details relating to the structure of the nucleus, this was, until quite lately, practically all that we knew regarding the parts composing either the animal or the vegetable cell. There appears, however, to be yet another something which, although in point of size it is of very insignificant dimensions, yet in point of function may perhaps be looked upon as transcending in importance, in some respects, both the protoplasm and the nucleus. Not many years ago it was noticed by various observers that in certain specialised animal cells the protoplasm showed a tendency to radiate from or converge towards a particular point, and on further investigation it was found that at this point there was a minute particle. This observation, which began, as we have seen, upon specialised cells, was, after a little while, found to hold good for other and yet other cells, until, at the present time, *we believe that in every cell of the animal or plant body*

[1] The President's Address, British Association Meeting, Oxford, 1894. Section I.—Physiology, by Professor E. A. Schäfer, F.R.S.

[2] i.e. Cells.

such a particle exists.[1] Now, it may well be asked, why after all should so great importance be attached to this observation? To this it may be replied that, in the first place, it is of importance, because it shows conclusively that the whole cell is not of a uniform nature, since there is this one point within the cell *that exerts a special attraction upon the rest of the cell-substance; and, indeed, on this account the particle has come to be termed the 'attraction particle.'*[2] And in the second place, because of the apparent universality of the occurrence of such a particle. And, thirdly, because of the fact that one of the most important phenomena exhibited by the cell hinges upon the behaviour of this particle; for it is found that before a cell or its nucleus divides,[3] this minute attraction particle begins by itself dividing, and is, in fact, more commonly met with double than single. Nor is it until the two particles thus produced have evolved, either from themselves or from the substance of the protoplasm or nucleus, a system of communicating fibres, the so-called *achromatic spindle*, that those changes in the nucleus and protoplasm take place which produce the division and multiplication of the cell. This *attraction particle*,[4] which is also called the *central particle* or *centrosome*, has absorbed so great an interest that, short as is its history,

[1] The italics are ours.

[2] The italics are ours.

[3] A cell generally multiplies by dividing itself into two cells, these again into four, these four into eight, and so on: thus cell multiplication tends to be in geometrical ratio.

[4] Since this was written further investigation leads to a doubt if this particle is a centre of attraction, but better expressed, it is a condensation or focal point of convergent activity. Either view suits the argument we are dealing with. If this particle does not "initiate and direct" it is intimately associated with such reactions.

many papers have already been devoted mainly to it, the latest of these being an elaborate treatise of some 300 pages by Martin Heidenhain. I shall not here attempt to follow out the details of all these researches, but will be satisfied with putting before you the conclusion which Heidenhain has come to regarding this particle, viz., 'That it is morphologically, physiologically, and chemically a structure *sui generis;* not merely a separate portion of nucleus or of protoplasm, but an organ of the cell with definite functions, and having a definite existence of its own.' Nevertheless, it is almost as minute an object as it is possible to conceive. In a cell which is magnified a thousand diameters the central particle appears merely the size of a pin point. Yet this almost infinitely small object exerts an extraordinary influence over the whole cell, however large (and the cell may be many thousand times its size), *for it initiates and directs those processes which result in the multiplication of the cell, and indirectly, therefore, it is concerned in directing the general growth of the individual, and ultimately the propagation of the species.*" [1]

In the above quotation the point to centre the mind on is expressed in the words "attraction particle." We might also call it the molecular centre of energy.

We now begin to feel the evidence closing around us. There are gradations of powers of atoms. Atoms have the power to form molecules, molecules to form cells. The molecules, which form the central group of molecules—the nucleolus, formed under the influence of a molecule perfectly invisible to the human eye, even

[1] The italics are ours.

with the highest powers of the microscope. And this molecule formed by an atom, but all subordinate to and guided by that factor of factors, *the Ether*. No Ether, no life, commonly expressed in these terms, No warmth, no life. Wonderful indeed—marvellously complex! All in conformity to order and within the grasp of the human mind!

STATEMENT No. 13.

Cells under the influence of the strongest cell group themselves to form highly complex structures or organisms, hence the most complex of all organisms—MAN. The activity of cells forms that activity we call Human Life. Thus life is the sum of the activity or energy of molecules formed of atoms.

HAVING now obtained the conception of the fundamental operations in Nature, we will proceed to study the main facts explaining the mode adopted by Nature to build up that most complex of beings, the human being.

The fundamental operation is always the following: That which forms the human being (and all objects which we call animal and vegetable life) is derived from external sources. Man grows, lives, and thinks by absorbing food and the molecules existing in the air —all are molecular.

Air, we now know, is very complex; besides the objects called "germs" held suspended in the air, it also contains free atomic matter (Argon) which will not combine with the simple atoms, but only with the most complex grouping of atoms. These plentiful, but relatively rarer species of atoms, man is constantly

absorbing, either with his food or by means of the lungs and, perhaps in a small part, by the skin surface.

Certain of these rarer atoms, existing not only in air, but probably in all other material, having thus obtained access into the circulating system, are arrested in a suitable soil, called the ovary of the female. This is no exception to the order of things. Every part of the body has its selective property. The selection always takes place from the blood. The knowledge of this fundamental fact is the basis of the principles of medicine. Its study in the division of labour is the province of the physician and the doctor.

"Many medicines," says Dr. Louis Büchner, "after being received in the animal body, show a decided predilection for the individual organs, tissues, or systems of that body, especially for the nervous system and its subdivisions. Some act upon the peripheral nerves, others upon the spinal cord, others upon the brain. It is therefore manifest, that these medicines, carried with the blood through the whole system, are only attracted in certain spots."[1] The study of these spots and the medicine which will react on them in a beneficial way, is the science of medicine. Not only with medicine is this a fundamental fact, but our food is digested and enters into the circulation, and each part of the body selects from the very complex compound, the blood, that which is necessary to repair the waste continually going on during life.[2]

[1] "Force and Matter," Dr. Louis Büchner, 1864, p. 181.

[2] "We recognize, then, that the absorption of digested matter depends upon two conditions: firstly, a physical condition—the diffusibility of the digested material; secondly, a physiological condition—the selective activity of the epithelium through which

Well, then, we see by what means atoms and molecules enter the body. In the human female there are two well-marked objects, each called an "ovary," and here by the same selective capacity are arrested the atoms, now formed into complex molecules, which form the eggs from which the human being is developed. The ovary is a sack of eggs. As the roe is to fish, so is this sack of eggs to the human being.

Fig. 9.—The organs of generation of the human female (on the right the membrane which remains on the left side has been cut away), showing in the upper part one of the Fallopian tubes and below one of the sacs of eggs—the ovary. In the centre is the womb.—(From Quain and Wilson's Anatomical Plates, reduced.)

The egg is very minute at first. It absorbs by its *inherent power* food, *i.e.* molecules, from the blood and thereby grows. A time comes when it is large enough to be seen by the microscope. Imbedded in the body of

absorption is effected."—("An Introduction to Human Physiology." A. D. Waller, M.D., F.R.S., 1896, p. 162.) "Living tissues are constantly in a state of chemical change, consuming and assimilating to themselves materials which they derive from the blood, and rejecting the consequent waste products. These are discharged into and carried away by the blood, which contains, therefore, the materials in the used-up form, viz. *carbonic acid* and *urea*.—(*Idem*, p. 10.)

these sacks of eggs, these objects are seen in various stages of growth. In the mass of the ovary are small cavities in which one or more of the eggs are placed somewhat as we see seeds in a pod. The *ova*, as these eggs are technically termed, count by thousands. At certain times in the life history of the human female it is estimated there are as many as 70,000 ova in the two ovaries.[1] An incipient population for a town! During

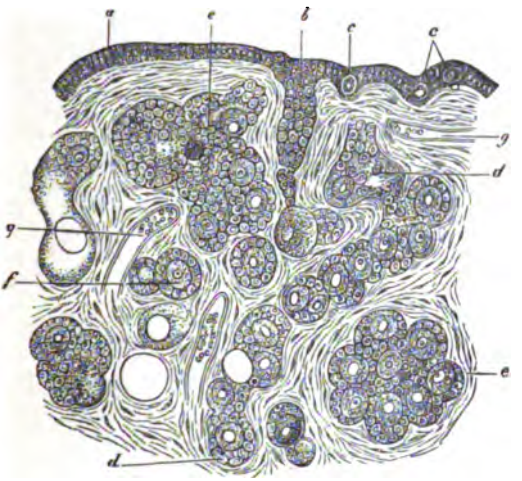

Fig. 10.—Very thin section of part of the ovary of a newly-born child, highly magnified. *d. d. e. e.* Nests of forming eggs. *c. f.* Eggs of the human being.—(From Quain's "Elements of Anatomy," vol. i., part 1, Embryology. 1892, p. 125.)

the life history of the human being, these sacks of human eggs are in a constant state of change. The eggs—groups of molecules—are constantly being cast away and new ones maturing.

"A continual change seems to be taking place in the

[1] Quain's "Elements of Anatomy," 10th edition, 1892, vol. i. part 1, p. 125.

contents of the Ovarium[1] during the greater part of life; certain of the Ovisacs or Graafian vesicles,[2] and their contents, successively arriving at maturity, whilst others degenerate and die. According to the valuable inquiries of Dr. Ritchie, it appears that even during the period of childhood, there is a continual rupture of the ovisacs and discharge of ova, at the surface of the ovarium.[3]. . . At the period of puberty, the stroma of the ovaries is crowded with ovisacs, which are still so minute, that in the ox (according to Dr. Barry's computation) a cubic inch would contain 200 *millions* of them."[4]

Now we are obtaining some faint ideas of the power of the individual to reproduce its kind. Keeping in mind that during the child-bearing life of the individual, these

[1] The Ovarium is the specialist's term for the sack of eggs—the human roe.

[2] That is the cavities of the ovarium in which the egg or eggs are placed as seeds are placed in a pod. There is, however, this difference with seeds: there is a small stem connecting each with the pod. Eggs are generally free in the cavity, the ovisacs.

[3] "A moment's consideration, however, will show that in most cases the organism does not wholly die. Some of the cells usually escape from the bondage of the body as reproductive elements,—as, in fact, Protozoa once more. The majority of these may indeed be lost; eggs which do not meet with male elements perish, and the latter have even less power of independent vitality. But when the ova are fertilised, and proceed to develop into other individuals, it is plain that the parent organisms have not wholly died, since two of their cells have united to start afresh as new plants or animals. In other words, what is new in the multicellular organism, namely, the 'body,' does indeed die, but the reproductive elements, which correspond to the Protozoa, live on."—("The Evolution of Sex," Professor Geddes and J. A. Thomson, 1889, p. 261.)

[4] Carpenter's "Principles of Human Physiology," 9th edition, 1881, p. 876.

eggs which are independent living objects, are being created and cast into the world as perfectly organized beings up to a certain stage, the mind is astounded at the thousands upon thousands of living creatures which are created in the body of one individual. Thus creation, that is, the combining of atoms to form molecules, and molecules to form cells, is going on hour by hour, day by day, year by year, epoch by epoch. A perpetual, eternal production and reproduction. *An eternal generation and regeneration.*

Between these two sacks of eggs is a small chamber in the human body, highly charged with blood vessels, and capable under certain conditions of considerable distension. Its enclosed cavity is under normal conditions the receptacle of the ripe egg. It is technically termed the *uterus* or womb (fig. 9). When the unfertilized egg is matured in the cavity of the ovarium it bursts its envelope. It is now an absolutely free creature. It starts its independent life. Attached to the upper or broader part of the womb are two tubes —the Fallopian tubes (fig. 9), one orifice of each tube connects with the interior of the womb, the other end of each tube is fringed out into finger-like processes, and so placed that when a ripe egg bursts the ovarium, its passage into the tube is ensured, and then the egg is wafted along by the lining cells of the tube. The cells (fig. 14), which line these tubes have little hair-like processes technically called *cilia*, and by these cilia the little egg is urged along the tube until it is placed safely in the womb.

Men ask for miracles! There is probably no reported miracle so wonderful as these operations and the changes which commence now. If the egg is fertilized

and the conditions are suitable, it immediately begins to grow, from its *own inherent powers*,[1] just as a seed does in the soil and governed by the same laws. If it is not fertilized, it is cast forth to die: Nature murders her offspring.[2]

[1] "From the time that the ovum quits the ovary, it ceases to be a part of the parent, and is dependent on her only for a due supply of nourishment, which it converts by its own inherent powers into its proper fabric."—(Carpenter's "Principles of Human Physiology," 9th edition, 1881, p. 895.)

[2] When we consider the probable prime cause of all wars, viz. over-population; when we consider that all diseases are created by powers mostly beyond our control; when we consider that famine is produced by natural laws also, which, in our present ignorant condition, we cannot control—when we consider that all these, apparently to us, dreadful calamities, are forced upon us by Nature, that they fundamentally are the acts of Nature, then we get some idea of the stupendous and apparently indiscriminate manner in which Nature murders her offspring. There is no morality, no religion, no mercy in Nature. Sir John Herschel wrote,* "For the benefit of those who discuss the subjects of Population, War, Pestilence, Famine, &c., it may be as well to mention that the number of human beings living at the end of the hundredth generation, commencing from a single pair, doubling at each generation (say for thirty years), and allowing for each man, woman, and child an average space of four feet in height, and one foot square, would form a vertical column, having for its base the whole surface of the earth and sea spread out into a plane, and for its height 3,674 times the sun's distance from the earth!"

The mean distance of the sun from the earth is over ninety-two millions of miles. Remark, this accounts for the would be *living* population, it does not account for the, so called, dead matter of which the dead human being was composed, and this also takes no account of the innumerable number of human beings in their initial stages, which as we have seen are being constantly destroyed, nor of other organisms which develop and grow and die, the same as the human being.

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* *Fortnightly Review*, No. 1, May 15th, 1865, p. 83.

In the seed, the fundamental initial property or force is in the seed, the secondary fundamental factor is the soil. If the soil be rich, and gives the seed the required molecular constituents, the seed thrives; if it be poor, the life of the seed wanes and dies. So with the fertilized egg. Its soil is the womb, and if the nourishment from the womb is rich and healthy, and no shock be given to its ordinary development, the egg develops, that is, cells are added to cells—the egg grows. And in

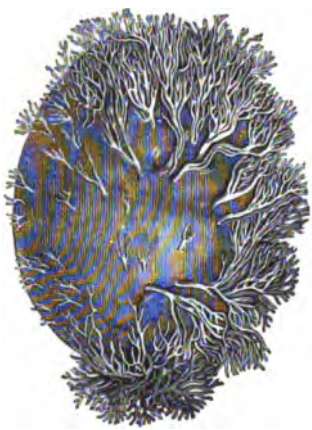

Fig. 11.—The growing Human Egg, eight weeks old, slightly magnified.—(From Carpenter's "Principles of Human Physiology," 9th edition, 1881, p. 889.)

order to obtain nourishment, the egg puts forth roots[1] (fig. 11) just as a seed does, which roots enter the

[1] "The surface of the ovum . . . during the first three or four weeks lying loose in the fœtal chamber, is rendered shaggy by the growth of villous tufts from the surface of its investing Chorion, . . . by which it begins to be attached to the walls that surround it." . . . "At the free extremity of each villus is a bulbous expansion," . . . "and it is at this point that the most active processes of growth take place," . . . "and (like the spongiole of the plant) drawing in nutriment from the soil in which it is imbedded."—(Carpenter's "Principles of Human Physiology," 9th edition, 1881, p. 888.)

substance of the womb—its soil; the egg becomes a parasite to its host—the human female. During the growth of the egg come the marvellous changes by which the simple fertilized egg-cell becomes a human infant.

The contents of the egg[1] or cell are mostly a mass of protoplasm, a highly complex mass of molecules, called by the specialist, the Yelk. Inside this mass of protoplasm lies an object technically called the nucleus, and inside that probably another object, the nucleolus, as described by Professor Schäfer on page 80. Presently there appear two vastly minute objects, which are probably centres of attraction or convergent activity, and in relation to these centres. The whole yelk divides itself into two separate egg-shaped bodies lying side by side like two very minute eggs within the spherical egg. And these two

[1] "The human egg cannot be distinguished from that of most other Mammals, either in its immature or in its more complete condition. Its form, its size, its composition, are approximately the same in all. In its fully developed condition, it has an average diameter of $\frac{1}{10}$ of a line, or 0·2 millimetres. If the mammalian egg is properly isolated and held on a glass plate toward the light, it appears to the naked eye as a very fine point. The eggs of most of the higher Mammals are of exactly the same size. . . . Even under the highest magnifying power of the best microscope, there appears to be no essential difference between the eggs of Man, of the Ape, of the Dog, etc. This does not mean that they are not really different in these different Mammals. On the contrary, we must assume that such differences, at least in point of chemical composition, exist universally. Even of human eggs, each differs from the other. In accordance with the law of individual variation, we must assume that 'all individual organisms are, from the very beginning of their individual existence, different, though often very similar.'"—("The Evolution of Man," Prof. Ernst Haeckel, vol. i. 1883, pp. 135-137.)

Hence there must be protoplasms and protoplasms, but the microscope fails in detecting the differences of composition.

bodies again divide, giving four objects, and these four again into eight objects, and so on from eight to sixteen, to thirty-two, to sixty-four, and thus they increase in geometrical progression. As they increase in number they become smaller; as they increase in number the whole mass of the egg increases in volume. And thus pressing side by side, the spheroidal cells, pressed together, become angular, attach themselves to each other, and in this way is formed a cellular skin or membrane. Membrane then overlaps membrane until the fundamental compound membrane is formed. It is a concentric formation like the layers in an onion.[1] And from these concentric membranes, by

[1] "The first step in the development of the mammalian ovum is cell-multiplication; the first step in organisation is the regular arrangement of its now numerous cells as a vesicle, the blastodermic vesicle, with an accumulation of small granular cells at one pole—the future blastoderm. The first step in differentiation is the distinction visible between upper or outer and lower or inner ranks of cells at this spot, soon followed by an obvious triple division into upper or *epiblastic* lower or *hypoblastic*, and middle or *mesoblastic* layers. This tripartite distinction is fundamental; the different tissues and organs in adult life are traceable back to these three stocks respectively, and already in the three ancestral membranes we may recognise in the germ a differentiation of function that is preserved throughout life. The upper or external layer is neural; it will form epithelium—the general epithelium of the skin, the special epithelium of sense-organs, and, by involution, the central axis of the cerebrum and spinal cord. The lower or internal layer, lying on the yolk, is nutritive; it will form the digestive and absorbent epithelium of the intestine and intestinal glands. The middle layer is the massive working layer, the future bone and muscle of the body, and at a very early stage shows tokens of the depuratory and excretory functions which are among its functions in after-life; it is the nidus of origin of the entire vascular system and of the blood, and one of the earliest organs to appear in

a process which is absolutely marvellous, are formed the cells (each of which has its nucleus and probably its nucleolus) of which nearly the whole structure of the living being, before birth and after birth, is composed.

Yes, the human being is formed of these cells and the molecular secretions or formations made by these cells.[1] They are always made of that which the human being absorbs. Each cell is a living being.[2]

And now to continue the early alterations in the egg, there comes another change on the scene. On the surface of these membranes, the spherical mass, a thickening takes place, and in this a straight hollow groove is formed, and this is the commencement of the brain and spinal cord. The whole mass ultimately wraps itself into a complex, somewhat cylindrical mass closed at each end. "The human embryo," as the incipient human being is called, "passes through a stage in which

it is the Wolffian body, which forms in the adult the essential parts of the renal and generative organs—of the kidney, testicle, and ovary."—("An Introduction to Human Physiology," A. D. Waller, M.D., F.R.S., 1896, p. 579.)

[1] In many cases these secretions act as a sort of cement or mortar—just as bricks are held together by mortar, so are cells held together by a sort of "cement-material," which is secreted by the cells.—(See Quain's "Elements of Anatomy," vol. i. part 2, 1893, p. 172.)

[2] "No satisfactory progress can be made till the idea of highly-organized living things as units had been set aside; till it was recognized that they were in reality organisms, each constituent part of which had its special life. Ultimate analysis of higher animals and plants brings us alike to the cell, and it is to these single parts, the cells, which are to be regarded as the factors of existence. . . . In a medical school, where the teaching is almost exclusively concerned with human beings, this sentence should be written large:—'The organism is not an individual, but a social mechanism.'" (The second Huxley Lecture, delivered by Prof. R. Virchow, October 3rd, 1898.)

it possesses no head, no brain, no skull, in which the trunk is entirely simple and undivided into head, neck, breast, and abdomen, in which there is no trace of limbs, arms, or legs." [1]

Presently the head and limbs bud out of this, one might almost say shapeless mass, much as a flower buds out of the stem of a plant. And thus part by part are put together, all the various components of which an infant is constructed.[2] But always, except the blood and the liquid secretions, it is a structure of cell lying in contact with cell, or divided only by the material secreted by the cells. Always each cell with its nucleus and probably its nucleolus. Every cell a mass of molecules. Every molecule a mass of atoms.

In describing an analogous process in the dog, the late Professor Huxley stated: [3] "Nature, by this process, has attained much the same result as that at which a human artificer arrives by his operations in a brick-field. She takes the rough plastic material of the yelk and breaks it up into well-shaped tolerably even-sized masses—handy for building up into any part of the

[1] "The Evolution of Man," Prof. Ernst Haeckel, vol. i. 1883, p. 253.

[2] "The human individual requires nine months for its perfect development from the fertilized egg-cell to the moment at which it is born and quits the mother's body. The human embryo, therefore, passes through the whole course of its development in the brief space of 40 weeks (usually in exactly 280 days). Each man is really older by this period than is usually assumed. When, for example, a child is said to be 9¼ years old, he is in reality 10 years old. For individual existence does not begin at the moment of birth, but at the moment of fertilization."—("The Evolution of Man," Prof. Ernst Haeckel, vol. ii. 1883, p. 3.)

[3] "Evidence as to Man's Place in Nature," 1864, p. 62.

living edifice. Next, the mass of organic bricks, or *cells*,' as they are technically called, thus formed, acquires an orderly arrangement, becoming converted into a hollow spheroid with double walls. Then, upon one side of this spheroid, appears a thickening, and, by and bye, in the centre of the area of thickening, a straight shallow groove (fig. 12 A) marks the central line of the edifice which is to be raised, or, in other words, indicates the position of the middle line of the body of the future dog. The substance bounding the groove on each side next rises up into a fold, the rudiment of the side

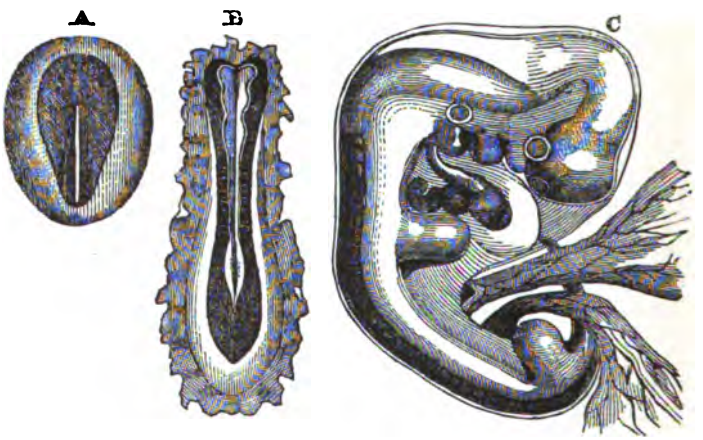

FIG. 12.—A, Earliest stages in the development of the dog; B, Rudiment further advanced, showing the foundations of the head, tail, and vertebral column; C, The very young puppy.—(From "Man's Place in Nature," by Thos. Hy. Huxley, F.R.S., 1864, p. 63.)

wall of that long cavity, which will eventually lodge the spinal marrow and the brain; and in the floor of this chamber appears a solid cellular cord, the so-called '*notochord*.' One end of the inclosed cavity dilates to form the head (fig. 12 B), the other remains narrow, and eventually becomes the tail; the side walls of the body

are fashioned out of the downward continuation of the walls of the groove; and from them by and bye, grow out little buds which, by degrees, assume the shape of limbs. Watching the fashioning process stage by stage, one is forcibly reminded of the modeller in clay. Every part, every organ, is at first, as it were, pinched up rudely and sketched out in the rough; then shaped more accurately; and only, at last, receives the touches which stamp its final character."

For a considerable period in the growth of the dog, there is no essential difference *in appearance* between its growth and that of any of the vertebrate animals, including Man. "Thus," continues Huxley, "the study of development affords a clear test of closeness of structural affinity, and one turns with impatience to inquire what results are yielded by the study of the development of Man. Is he something apart? Does he originate in a totally different way from Dog, Bird, Frog, and Fish, thus justifying those who assert him to have no place in nature and no real affinity with the lower world of animal life? Or does he originate in a similar germ, pass through the same slow and gradually progressive modifications,—depend on the same contrivances for protection and nutrition, and finally enter the world by the help of the same mechanism? The reply is not doubtful for a moment, and has not been doubted any time these thirty years. Without question, the mode or origin and the early stages of the development of Man are identical with those of the animals immediately below him in the scale:—without a doubt, in these respects, he is far nearer the Apes, than the Apes are to the Dog."

Haeckel describes the development thus: "In the

first stage of the evolution of the individual, many homogeneous cells first arise, from the simple egg-cell, by continuous division. These are exactly comparable to a community of human beings as yet uncivilized. These homogeneous cells increase still more, so that the accumulation of cells ever increases. As in making our comparison we found that an entire colony of savages proceeded from the descendants of a single isolated human pair, so likewise all the homogeneous cells of this multitude . . . are inter-related as the descendants of a single pair of cells. Their common father is the male sperm-cell, and their common mother the female egg-cell. At first, all these numerous cells which arise by the continuous division of the fertilized egg-cell, are exactly alike, and cannot be distinguished from each other. But gradually a division of labour occurs among them by their assuming different offices. Some accomplish nutrition, others reproduction, others protection, others locomotion, and so on. We may translate this into the language of the theory of the tissues and say: some of these cells become intestinal cells, others muscle-cells, others again, bone-cells, nerve-cells, cells of the sense-organs, of the reproductive organs, &c." [1] Yes, but always the cells are derived from without, each with its nucleus and probably its nucleolus. Each cell is formed of molecules, which molecules are formed of atoms, and absolutely always developed by means of that factor of factors, the fluid Ether. For without Heat, i.e. the reaction of Ether on the atom and molecule—no life.[2]

[1] "The Evolution of Man," Prof. Ernst Haeckel, vol. i. 1883, p. 154.

[2] That the evolution of the organism depends upon the current of Ether, or what is termed Heat, is clearly shown in the hatching of

And continues Professor Huxley, "The student of Nature wonders the more and is astonished the less, the more conversant he becomes with her operations; but of all the perennial miracles she offers to his inspection, perhaps the most worthy of admiration is the development of a plant or of an animal from its embryo. Examine the recently laid egg of some common animal, such as a salamander or a newt. It is a minute spheroid in which the best microscope will reveal nothing but a structureless sac, enclosing a glairy fluid, holding granules in suspension.[1] But strange possi-

an ordinary chicken's egg. Here we find *only* Heat is required to develop the perfect organism, the chicken, for we can perform the operation by means of an incubator, that is, a heat-developing apparatus.

[1] This is a common description for the egg-cell in its initial conditions. Now as a great many eggs are developed in water and quite away from the influence of the parent, and each egg produces the like of the parent, it must follow the contents of each species of egg must consist of different species of molecules. This shows that as an instrument of analysis of molecular structure the microscope fails. There must be protoplasms and protoplasms.

"*Chemistry of the Egg*,— . . . The subtle protoplasm itself, it need hardly be said, defies analysis."—("The Evolution of Sex," Prof. P. Geddes and J. A. Thomson, 1889, p 104.)

"Protoplasm is regarded as an exceedingly complex and unstable compound, undergoing continual molecular change."—*Idem*, p. 87.

"Protoplasm is excitable. When any part of a lump of protoplasm is excited, the lump moves. When many lumps of protoplasm are gathered into a homogeneous mass, excitations and movements may be transmitted from lump to lump in all directions. . . . An amœba is a simple lump of protoplasm, excitable and contractile in all parts of its substance, and not more so or less so in one part than in another."—("An Introduction to Human Physiology," A. D. Waller, M.D., F.R.S., 1896, p. 290.)

"The literal meaning of the word excitation is 'call from with-

bilities lie dormant in that semi-fluid globule. Let a moderate supply of warmth reach its watery cradle, and the plastic matter undergoes changes so rapid and yet so steady and purposelike in their succession, that one can only compare them to those operated by a skilled modeller upon a formless lump of clay. As with an invisible trowel, the mass is divided and subdivided into smaller and smaller portions, until it is reduced to an aggregation of granules not too large to build withal the finest fabrics of the nascent organism. And, then, it is as if a delicate finger traced out the line to be occupied by the spinal column, and moulded the contour of the body; pinching up the head at one end, the tail at the other, and fashioning flank and limb into due salamandrine proportions, in so artistic a way, that, after watching the process hour by hour, one is almost involuntarily possessed by the notion, that some more subtle aid to vision than an achromatic, would show the hidden artist, with his plan before him, striving with skilful manipulation to perfect his work.

"As life advances, the young amphibian ranges the waters, the terror of his insect contemporaries, not only are the nutritious particles supplied by its prey, by the addition of which to its frame growth takes place, laid down, each in its proper spot, and in such due proportion to the rest, as to reproduce the form, the colour, and

out.' The surroundings of an organism '*ex-cite*' its specially excitable parts, and the organism moves to or from its surroundings, or registers an impression which will modify its future movements." —(*Idem*, p. 291.)

And so also can quicksilver be excited. Electrify, under suitable conditions, masses of quicksilver, and the masses give movements very much like the living amœba does!

the size, characteristic of the parental stock; but even the wonderful powers of reproducing lost parts possessed by these animals are controlled by the same governing tendency. Cut off the legs, the tail, the jaws, separately or all together, and, as Spallanzani showed long ago, these parts not only grow again, but the reintegrated limb is formed on the same type as those which were lost. The new jaw, or leg, is a newt's, and never by any accident more like that of a frog.[1] What is true of the newt is true of every animal and of every plant; the acorn tends to build itself up again into a woodland giant such as that from whose twig it fell; the spore of the humblest lichen reproduces the green or brown incrustation which gave it birth; and at the other end of the scale of life, the child that resembled neither the paternal nor the maternal side of the house would be regarded as a kind of monster. . . . It is the first great law of reproduction, that the offspring tends to resemble its parent or parents, more closely than anything else. Science will some day show us how this law is a necessary consequence of the more general laws which govern matter; but, for the present, more can hardly be said than that it appears to be in harmony with them. We know that the phenomena of vitality are not something apart from other physical phenomena, but one with them; and matter and force are the two names of the one artist who fashions the living as well as the lifeless. Hence living bodies should obey the same great laws as other matter—nor, throughout Nature, is there a law of wider application than this, that a body impelled by

[1] This is evidence that the controlling of formation of molecules to build up the organism is a centrifugal and not a centripetal power.

two forces takes the direction of their resultant. But living bodies may be regarded as nothing but extremely complex bundles of forces held in a mass of matter, as the complex forces of a magnet are held in the steel by its coercive force; and, since the differences of sex are comparatively slight, or, in other words, the sum of the forces in each has a very similar tendency, their resultant, the offspring, may reasonably be expected to deviate but little from a course parallel to either, or to both."[1]

Now having traced the growing organism in the womb, let us go farther.

A new departure takes place—the child is born, and it is a very imperfect creature. The mother looks at it with endearment, loves it, and pities its weakness. She regards it as blood of her blood, and flesh of her flesh. It would appear this is not wholly the case. It is a living atom, as it were by accident, entering into the body of the mother, aggregating to itself hosts of atoms in the form of molecules from the maternal blood,[2] departmentizing these molecules to build up the organism, living on the blood of the mother in exactly the same way as the seed appropriates to itself the nourishment from the earth. If the seed is a parasite to the earth, so is the germ a parasite to the mother.[3]

[1] "Lay Sermons, Addresses, and Reviews," T. H. Huxley, LL.D., F.R.S., 1893, pp. 226-228.

[2] "Though no drop of blood ever passes from mother to offspring, a very intimate osmotic transfusion is effected."—("The Evolution of Sex," Prof. Geddes and J. A. Thomson, 1889, p. 249.)

[3] "The egg of vivipara, left in condition of complete activity, engrafts itself upon the maternal womb like a parasitic plant."—("Metamorphoses of Man and the Lower Animals," Prof. A. de Quatrefages, 1864, p. 11.) "The young mammal is thus enabled to become what

The child is non-intelligent, helpless, soulless. Now commences a beautiful process in Nature showing how the loving care of the mother further develops the structure of the child. All her efforts are to feed it, to teach it the use of its inherent growing powers, of its senses as they grow—to teach it to speak and to walk. For the born infant is perfectly incapable of reason. All its actions are reflex. It has no mind—no soul. Give it some object to suck and it will suck it just the same as it sucks the mother's nipple. Even when it gets older it has no fear, it would as soon fall from the heights of the cliff as it would tumble off a footstool. This is, indeed, one of the mother's anxious cares. As the various cells increase and their secretions increase (always derived from food and the air), or as we commonly call it, as the child grows, the growing forces inherent in the cells are brought into play by the parent. Perfectly intuitively she is arranging the cells and their activities in their proper order. She teaches the child to use its hands, to respond to certain sounds. She teaches it a language. It is perfectly indifferent to the child what language it may be. It is capable of being educated in the narrow prejudices of *any* nation. All these and the thousand and one endearing actions of the mother are simply guiding the molecular alterations in the child, and in a most marked way those alterations which go on in the brain. She is educating her child.[1] And thus from infancy to school

is practically a temporary ecto-parasite upon the unfailing maternal . . . surplus."—("The Evolution of Sex," Prof. Geddes and J. A. Thomson, 1889, p. 245.)

[1] "It is because the body is a machine that education is possible Education is the formation of habits, a superinducing of an artificial

life, to the business or profession, from youth to manhood, go on those physical alterations which are seen in effects. We call these effects the result of education and experience.

organization upon the natural organization of the body; so that acts, which at first require a conscious effort, eventually become unconscious and mechanical. If the act which primarily requires a distinct consciousness and volition of its details, always needed the same effort, education would be an impossibility."—("Lay Sermons, Addresses, and Reviews," Thos. H. Huxley, LL.D., F.R.S., 1893, p. 293.)

"A child is 'impulsive,' reacts upon the suggestions of the moment—in a word, is a more automaton-like than a reflective self-controlled adult. Religious ecstasy, lover's imagination, ordinary dream chains, somnambulism, the deceptions produced by the distracting manœuvres of a juggler, offer more or less familiar instances of that concentration or predominance of a train of ideas—to the effacement of other accessory or modifying ideas and sensations—which in extreme degree is characteristic of the hypnotic state. Education is not only instruction, it is suggestion working upon brains more or less predisposed to reception, more or less pre-occupied by the effects of previous suggestions; and the influence of some persons upon the beliefs and conduct of others is an every-day instance of physiological hypnotism, the actual result depending upon two factors—upon the impressiveness of the operators, upon the susceptibility of the subjects. A hypnotised person is in a state of '*suggestibility*' or unsceptical credulity, which is a retrogression towards a primitive state, and an exaggeration of that working credulity of every-day life which enables us to acquiesce in and act upon simple statements without constantly exacting argument, or evidence, or proof. We naturally—in the absence of stronger reason to the contrary—believe what we are told, and imitate the actions of other people. Suggestions to ideas and to actions have more or less pronounced effects on persons of different temperament; they have an exaggerated or forced effect upon hypnotised subjects during the passive state, or even, it may be, in their ordinary awakened condition. All men are more or less automata; hypnotised subjects are excessively or completely automata."—("An Introduction to Human Physiology," A. D. Waller, M.D., F.R.S., 1896, p. 574.)

We will now take a brief look into a few of the objects of which the inner parts of the human body are built up. Here are the objects—cells (fig. 13) which

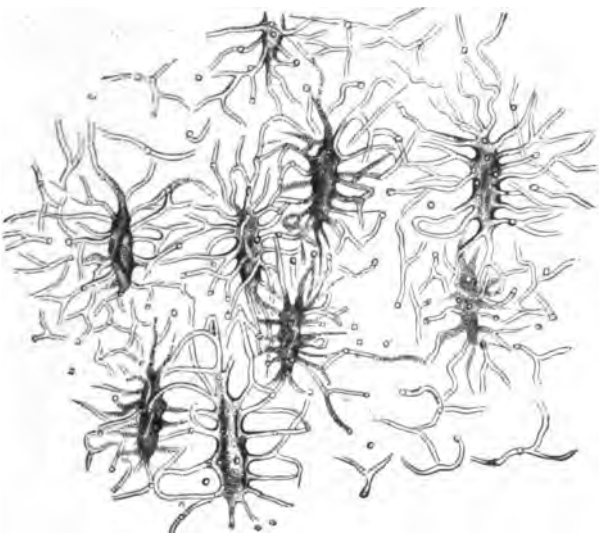

Fig. 13.—Nine star-shaped bone cells with branched processes, highly magnified.—(From Ernst Haeckel's "Evolution of Man," 1883, vol. i. p. 126.)

secrete the material called bone. As an oyster secretes its shell, so do these objects secrete from the blood the framework—the bony mass of the being.

Here are the objects (fig. 14) which line the wind-

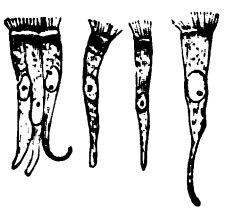

Fig. 14.—Ciliated cells, human, magnified 300 diameters.—(From Quain's "Elements of Anatomy," vol. i. part 2, 1893, p. 201.)

pipe to keep the air in motion; look at the little hair-like processes which waft the air in motion. Such objects as these lying side by side, carry the egg from the ovary into the womb.

Here is a section of the skin (fig. 15) showing the

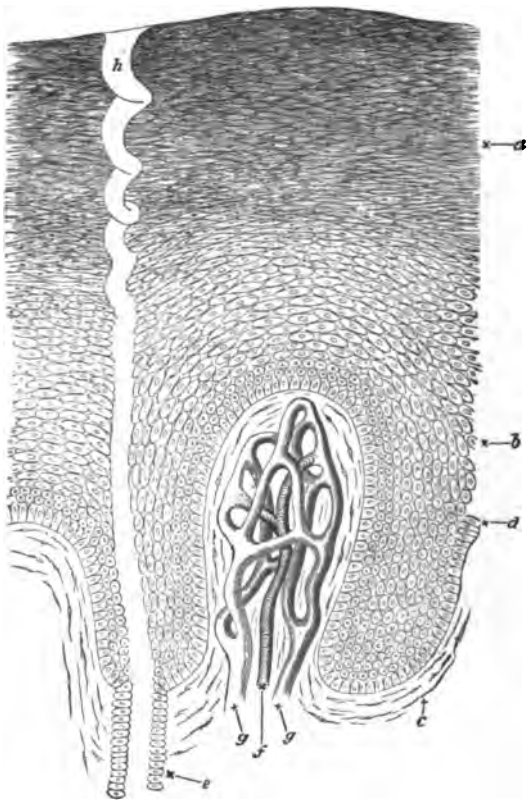

Fig. 15.—Section of skin highly magnified, somewhat diagrammatic. *a*, Horny epidermis; *b*, softer layer; *h*, sweat duct; *f*, small artery; *g*, *g*, small veins.—(From "Lessons in Elementary Physiology," by T. H. Huxley, F.R.S., 1893, p. 311.)

little cells lying side by side, perpetually dying on the outside, and we call them scurf.

Here are the dead cells which line the mouth (fig. 16), found in considerable numbers in the saliva: we swallow them; man is in part a cannibal and eats himself.

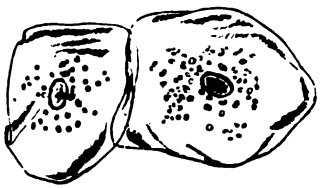

Fig. 16.—Cells from the lining of the mouth, seen in considerable quantities in the saliva, magnified 260 diameters.—(From Quain's "Elements of Anatomy," vol. i. part 2, p. 196.)

And here is that wonderful initial object, the Human

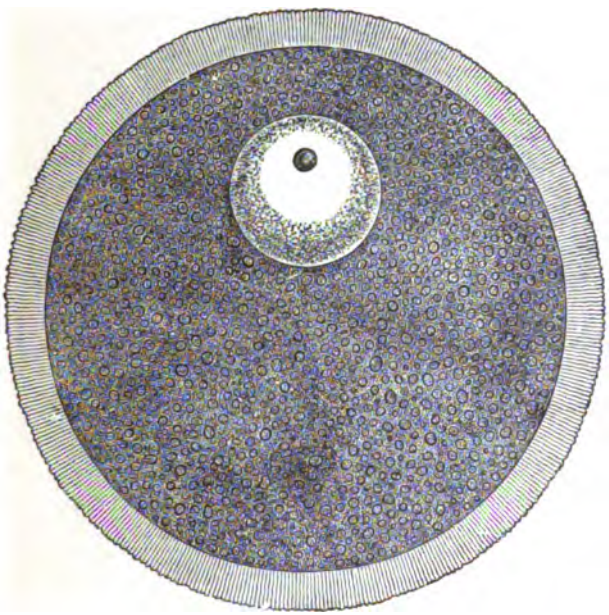

Fig. 17.—The Human Egg from the ovary of the female, much enlarged. The entire egg is a simple globular cell. The greater part of the cell is formed of egg yelk in which lies the nucleus, and inside this is the nucleolus. The yelk is surrounded by a transparent covering or membrane. (From "The Evolution of Man," Prof. Ernst Haeckel, 1883, vol. i. p. 122.)

Egg (fig. 17). An object, reader, *from which you, and every human being which ever existed, sprang.*[1]

We might amplify the illustration of these fundamental cells to a great extent. We have only desired to bring a few prominently before the reader, so that he or she may thoroughly grasp what manner of being he or she is.

All is in motion, new cells born by cell-division, cells in a state of growth, cells dying. Cells always made up of molecules, molecules made up of specific atoms. All is in—so called—death, all is regeneration, i.e. new life. If black is the emblem of death, we must all constantly wear black, for we are ever dying and cannot live without dying.

Life is a state of Change.[2] Cell life is the sum of

[1] "The opponents of the development theory, who regard this gradual development of Man from lower animal forms, and his original descent from a one-celled primitive animal as incredible, do not reflect that the same marvel actually recurs before our eyes in the short space of nine months during the embryonic development of each human individual. The same series of multifariously diverse forms, through which our brute ancestors passed in the course of many millions of years, has been traversed by every Man during the first 40 weeks of his individual existence within the maternal body."—("The Evolution of Man," Ernst Haeckel, 1883, vol. ii. p. 4.)

[2] "If, now, we inquire what it is that essentially distinguishes Vital from every kind of Physical Activity, we find this distinction most characteristically expressed in the fact, that a germ endowed with Life develops itself into an Organism of a type resembling that of its parent; that this organism is the subject of incessant changes, which all tend in the first place to the evolution of its typical form, and subsequently to its maintenance in that form, notwithstanding the antagonism of Chemical and Physical agencies which are continually tending to produce its disintegration; but that, as its term of existence is prolonged, its conservative power declines, so as to become less and less able to resist these disintegrating forces, to

molecular life. Molecular life is the sum of atomic life—this life is eternal.[1]

But it does not want the microscope to teach us this great fact. Let us consider the hair on our heads. It is probably on an average three inches long. We go to a hairdresser about once a month, and have an average of about an inch cut off. The hair cut off is so much dead matter—so called. Obviously in three months' time the hairdresser will have cut off the whole of the present crop of hair. The whole of the crop becomes,

which it finally succumbs, leaving the organism to be resolved by their agency into the components from which its materials were originally drawn. The history of a Living Organism, then, is one of *incessant change;* and the conditions of this change are to be found partly in the organism itself, and partly in the external agencies to which it is subjected."—("Carpenter's Principles of Human Physiology," 9th edition, 1881, p. 2.)

"The living body yields *energy* in the form of *work* and of *heat*. This result is brought about by chemical action. Matter is used up and becomes useless, organic compounds disintegrate and their waste products are got rid of. Consumption of matter is thus a primary condition of vital activity, and it is necessary to the continuance of life that new matter should take the place of spent matter. The food—proteids, fats, and carbohydrates—supplies the necessary new matter, and is the primary source of all body energy, by its transformation into work, heat and waste products. The essential waste products are *urea* and *carbon dioxide;* the essential elements in these waste products as well as in the food are *nitrogen* and *carbon*."—("An Introduction to Human Physiology," A. D. Waller, M.D., F.R.S., 1896, p. 248.)

[1] "Every variation of a living form, however minute, however apparently accidental, is inconceivable except as the expression of the operation of molecular forces or 'powers' resident within the organism. And, as these forces certainly operate according to definite laws, their general result is, doubtless, in accordance with some general law which subsumes them all."—("Critiques and Addresses," T. H. Huxley, LL.D., F.R.S., 1890, p. 298.)

as we call it, dead. The hair does not come out of the skull as string comes out of the string box. The new hair is generated in the skin of the head. And similarly do we cut away the whole of the finger-nails in a very short time. The average of the whole body regenerates very quickly. There is no rigid system. Hardly two hairs grow alike or at the same speed. Every part of the body differs in its order of regeneration. If regeneration, molecular and cellular, were not a fact, living matter could not exist.

Now let us consider the effect of this observation of the phenomena of our existence. Two men, friends, meet each other; it was a few months ago since last they saw one another. They are perfectly unconscious of the fact that they are absolutely two different individuals. It is patent that the hair has been cut off by the hairdresser—it is also evident that they have themselves cut away the finger-nails, that is, the nails which existed when they last met. Every time they have washed themselves they have left, what we call, dead-matter in the water, for the dead cells from the body are held in suspension. And lastly, they have been swallowing the dead cells from the lining of their mouths, every moment in their existence. And so, when we come to examine the inner operations, we find the same phenomenon—a constant life history of waste and repair—of the birth, growth, and death of the cells of which every human being is built up. When new cells develop faster than the death of cells, we have growth; when the death of cells exceeds the growth of cells, we have decline. Thus life and death may be regarded as the outcome of assimilations and waste —i.e. a balance in favour of assimilation leads up

to "growth," and that in favour of waste to decomposition and "death." When, as we shall presently see, the dominant controlling molecule, the commander-in-chief, ceases to control the organism of cells, we have, what we call, death, but not eternal death.

"The body is a machine of the nature of an army, not that of a watch or of a hydraulic apparatus. Of this army each cell is a soldier, an organ a brigade, the central nervous system head-quarters and field telegraph, the alimentary and circulatory system the commissariat. Losses are made good by recruits born in camp, and the life of the individual is a campaign, conducted successfully for a number of years, but with certain defeat in the long run.[1] The efficacy of an

[1] "It is especially necessary to conceive the cell as an integral organism, or, in other words, an independent living being. When by dissection we have separated the developed body of a Man, or of any other animal or plant, into its organs, and when we then proceed further to examine by means of the microscope the more minute constituents of these larger organs, which give the form to the whole organism, we are surprised to find that all these various parts are made up of the same fundamental constituents or structural elements; and these are cells. . . . it is only in the earliest period of individual existence that the organism is a simple cell; it afterwards forms a cell-society, or, more correctly, an organized cell-state. The human body is not in reality a simple life-unit, as is at first the universally current, simple belief of men. It is, rather, an extremely complex social community of innumerable microscopic organisms, a colony or a state, consisting of countless independent life-units, of different kinds of cells."—("The Evolution of Man," Prof. Ernst Haeckel, 1883, vol. i. pp. 123, 124.)

"A living body is not merely a homogeneous mass of living matter; the living matter or protoplasm has become differentiated and organised, and it has surrounded itself with protoplasm products. The lowest form of living matter is a simple cell, e.g. an amœba or a leucocyte. The highest form of living matter is the human body,

army at any given moment depends on the health of the individual soldier, and on the perfection of the machinery by which he is led and brought into action at the proper time." [1]

As usual, the late Professor Huxley's words are perfectly clear, beautifully expressed. Yes, the human being, all the higher organic bodies are complex armies, but it is to the central nervous system, the head-quarters and field telegraph we have to direct our attention, for it is from here the essential activities originate for the well-being of the individual *and the community*.

We know that in every army there is a supreme individual power. Without that power cohesion ceases. This is the incomplete part of the late Professor Huxley's analogy, and his analogy is in another fact defective.

which is literally a 'nation' of cells derived from a single cell called the ovum, living together, but dividing the work, transformed variously into tissues and organs, and variously surrounded by protoplasm products.

"In all living organisms a *physiological division of labour* is associated with *anatomical differentiation of structure*. An organism ranks high or low in the animal scale in accordance with the greater or less diversity of its tissues and functions; and in every organism above the lowest, portions of various tissues are found united into distinct masses forming *organs* and possessing *functions*—each organ served by and serving the entire organism. The organism is a community; its individuals are cells; groups of individuals are organs." —("An Introduction to Human Physiology," A. D. Waller, M.D., F.R.S., 1896, p. 2.)

"At a pressure of 15 atmospheres animals die in convulsions, at 20 atmospheres germination and putrefaction are arrested, i.e. no living cell can breathe."—(*Idem*, p. 147.)

[1] "Address at the International Medical Congress by Prof. Huxley." Quoted from the *Times* newspaper, August 10th, 1881.

Let us explain. An army has a gradation of officers from the lowest, the corporal, rising to the captain, the colonel, to the commander-in-chief. Now we find in the human organism a similar condition of things. The evidence tends that there are subordinate nervous cells—centres from which are, as it is called, reflected the nervous power, and these centres are connected by fibres to superior centres, and so on until we come to the centre of centres—the cell or cells which is the corresponding object in the body to that in the army—the commander-in-chief. This, however, has not been traced out. We can only reason from physiological effects. All phenomena which do not reach the chief centre are reflected back, often without the knowledge of that centre, and these are what are called, "reflex actions," by physiologists.

Dr. Waller states the facts in the following words: "A familiar comparison may serve to bring home to some minds a clearer picture of the relation that subsists between cerebral and spinal shares in the government of the body, and lead to a rational conception of the relative significance of the terms voluntary and reflex. An ordinary business enterprise, a factory, a political party, an army—in short, any body of men gathered together under leadership—is, like the collection of cells forming the animal body, led and controlled by certain individuals whom we may call nerve-centres and characterise as 'master centres' and as 'foreman centres.' The function of a master centre in a body, as in a business, is mainly that of administration, to initiate proceedings the detailed supervision of which is delegated to and carried out by foreman centres, to actually take part in supervision only of novel proceed-

ings or of proceedings that go awry; the function of a foreman centre is mainly that of immediate supervision, to execute instructions received from the master centre, to issue instructions in matters of routine without reference to head-quarters, but to inform and take instructions from the master centre as emergency arises. This is a true picture of the relations between the cortex cerebri* and the medulla spinalis,† as far as we know or can conceive them." [1]

We have seen through the whole organism, every cell has at least one nucleus and probably a nucleolus—the latter a central object—a group of molecules. We have seen that the evidence shows that every simple molecule consists of vesicular matter—atoms wrapping over each other to form molecules, that these molecules have the power of changing shape and volume just in proportion to the amount of Ether held by them at any instant of time.[2]

Every species of atom has its inherent and eternal properties; these are the energies of the atom or molecule and produce forces. Every molecule has the combined forces of the atoms of which it is built up. Let us regard the central atom, the commander-in-chief of the molecule. Is there a molecule which is the commander-in-chief of that wonderful complex army of cells—the human being?

Now, the evidence both of structure, physiological effects, and of our own personal inner consciousness, is

[1] "An Introduction to Human Physiology," A. D. Waller, M.D., F.R.S., 1896, p. 298.

[2] The experimental evidence proving this is most remarkable. See the author's work, "What is Heat?"

* i.e. peripheral cells of the brain. † i.e. spinal cord or marrow.

most remarkable. Let us take a section of one side of the brain, fig. 18, and what do we see?

Fig. 18.—Section of one hemisphere of the brain, showing the mass of grey-matter, built up of thinking cells, covering the surface of the brain and the fibres converging to the spinal cord at the base of the brain, or that part of the brain which is in the neck.—(From Quain's Anatomical Plates, "The Nerves of the Human Body" (reduced), 1839, p. 17.)

The main facts are: within the skull is a mass of cells of wonderfully complex structure. Fig. 19 gives a poor illustration of one of these all-important objects; they are very minute indeed. They vary in form enormously; but there is always the nucleus and probably nucleolus, even although we may not be able to see the latter.[1] They cover the whole of the surface of

[1] Very great difficulty often exists in being able to see the details of these minute objects. The difficulty is frequently got over by a process which is technically called "staining." The object is placed in coloured or other fluids, and certain parts of the structure absorb certain of the colours, or are chemically reacted on to give colour, and by this simple means the cells or the various details are often made visible by the microscope. But treating the cell in this way,

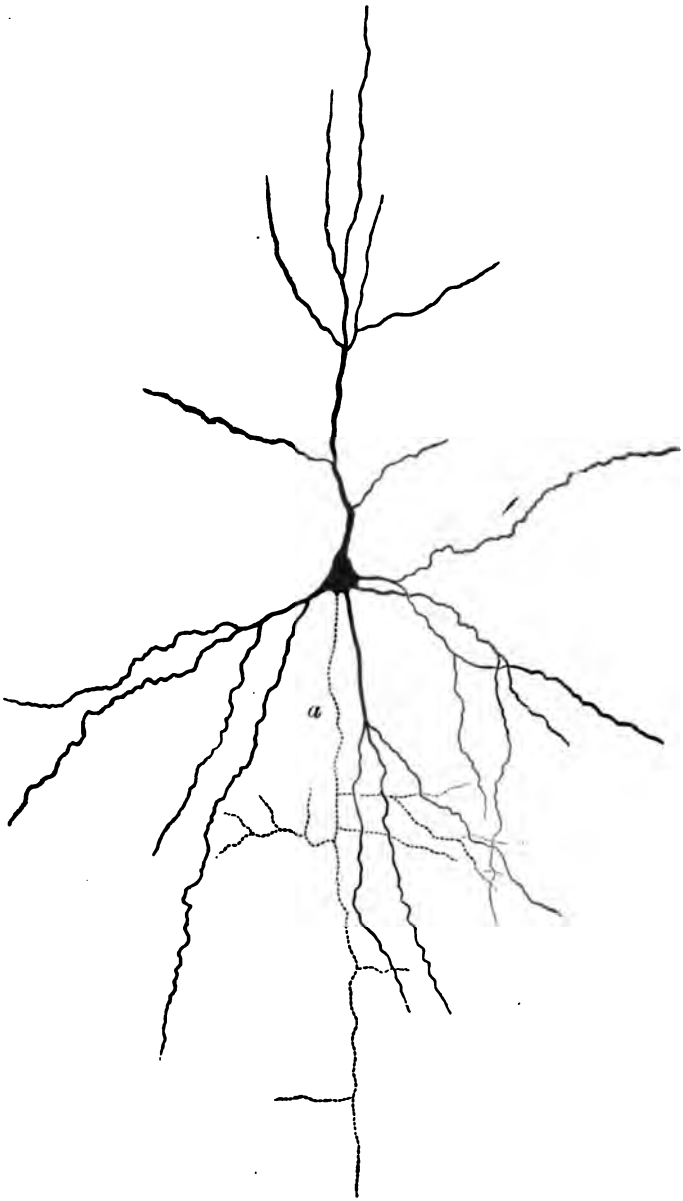

Fig. 19.—A thinking cell from the surface of the brain, magnified. *a*, The nerve-fibre which conducts to the central part of the brain.—(From Quain's "Elements of Anatomy," vol. i. part 2, 1893, p. 319.)

the brain, that is, that surface which is next the skull. These are the thinking cells.[1] They form, in mass, what is called the cortical substance of the brain, or the grey

while it makes the object visible as a whole, often obscures its structure; hence the nucleus and nucleolus, in these cases, become obscured. Now, the fact that there is this selective power in parts of these extremely minute creatures is very important to observe. It is exactly the same in principle as our magnet, our iron, and our nickel, as described on page 74. And it is also exactly the same, in principle, where the cells of which the body is composed, select from the complex mixture—the blood – the essentials for their development. But the nucleolus of some cells will not take the colour, at least, any known colour. Here, again, is the selective power in a negative sense. So that there are cells in which no nucleolus can be seen.

[1] "Our thoughts are the expression of molecular changes in that matter of life which is the source of our other vital phenomena."—("Critiques and Addresses," T. H. Huxley, LL.D., F.R.S., 1890, p. 283.)

"As there is no bile without liver, no urine without kidneys, so is there no thought without a brain: mental activity is a function of the cerebral substance. This truth is simple, clear, easily supported by facts, and indisputable."—("Force and Matter," Dr. Louis Büchner, 1864, p. 139.)

"That the brain is the organ of intelligent sensation and motion is proved by the facts of comparative anatomy already alluded to, and by common experience. The same proposition is established by clinico-pathological facts, and by the study of animals after removal of a hemisphere or of the cortex. Experimentally we learn that after removal of the cortex an intelligent animal is reduced to the state of a non-intelligent automaton, responding indeed to a stimuli, internal as well as external, but failing to interpret the significance of present events in accordance with bygone experience. A brainless dog is stupid; he may see a bone in front of his eyes without showing sign that he knows the meaning of a bone, or the use to which it may be put; he may hear the crack of a whip, but he no longer shows sign of fear, for he does not remember its sting; his former purposeful behaviour has entirely disappeared: in short, he has lost memory and judgment."—("An Introduction to Human Physiology," A. D. Waller, M.D., F.R.S., 1896, p. 530.)

matter of the brain. They constitute the outside layer of the brain, as seen in the illustration (fig. 18). These cells communicate with the white underlying matter of the brain, which consists of white nerve fibres, which in the main *converge at the base of the brain.* All is dreadfully complex.[1] We know but little about the brain, except its excessive complexity, but all tends to the following information. When the grey cells—the cortical cells—are active,[2] we think, and the product of

[1] "The 'nerve-centre' of mammalia and of man is a collection of nerve-centres occupying the cerebro-spinal axis, with more or less diverse special offices under their control—communicating each with the other upon occasions, yet separately active upon other occasions—having functions that are localised at certain parts, yet not strictly confined to these parts—playing upon and influencing each other in all directions, yet in some directions rather than in others, and maintaining some kind of precedence and rank, so that while all may influence all, yet some are usually guided and controlled by others—variously organised through past excitations, yet still variously organisable by excitations to come. To-day the state and disposition of organs and of the organism are the product of the past, immediate and remote, individual and ancestral. To-morrow and in the distant future they will become what they may be made to become by training, by education, and by new conditions of life."—("An Introduction to Human Physiology," A. D. Waller, M.D., F.R.S., 1896, p. 292.)

[2] "The nerve-cell which is formed for the highest activities of life, possesses the capacity to feel, to will, to think. It is a true mind-cell, an elementary organ of mental activity. Correspondingly, it has an extremely complex minute structure. Innumerable filaments of exceeding fineness, which may be compared to the numerous electric wires of a great central telegraph station, traverse, crossing each other again and again, the finely granulated protoplasm of the nerve-cell and pass into branched processes, which proceed from this mind-cell, and connect it with other nerve-cells and nerve-fibres. . . . We thus have before us a highly complex apparatus, the more minute structure of which we have hardly begun to know, even

that thought is conveyed to a central part near the base of the brain by the white fibres—the organic telegraph wires, and thence to that part of the spinal cord enclosed in the backbones, or, as they are called, the vertebræ. Here we have in the spinal cord the main telegraph cable, conveying the nervous impulses to the various parts of the body. Thus, just above the vertebral column, white fibres, or thread-like processes, converge, and from there are carried special lines to the eyes, the nose, the tongue, the ears.

with the help of our strongest microscope, and the significance of which we rather guess than know. Its complex mechanism is capable of the most intricate psychical functions. But even this elementary organ of mental activity, of which there are thousands in our brain, is only a single cell. Our whole intellectual life is but the sum of the results of the activity of all such nerve-cells or mind-cells. In the centre of each cell lies a large transparent ball, which encloses a smaller dark body. This is the nucleus which contains the nucleolus. Here, as everywhere, the nucleus determines the individuality of the cell and shows that the entire formation, notwithstanding its minute and complex structure, is in form only a single cell."—("The Evolution of Man," Prof. Ernst Haeckel, 1883, vol. i. pp. 127, 128.) "The human nervous system, like that of all other Mammals, is, in its developed condition, a very complex apparatus, the anatomical arrangement and the physiological activity of which may, in general terms, be compared to a telegraph system. The central marrow (*medulla*), or central nervous system, represents the principal station, the innumerable 'ganglion-cells' . . . which are connected with each other and with numerous very delicate conducting lines by their branched processes. The latter are the peripheric 'nerve-fibres' distributed over the whole surface of the body; these, together with their terminal apparatus, the sense-organs, &c., constitute the 'conductive marrow,' the peripheric nerve-system. Some, as sensory nerve-fibres, convey the sensations of the skin and of other sense-organs to the central medulla; others, as motor nerve-fibres, transmit the impulses from the central marrow to the muscles."—(*Idem*, vol. ii. p. 209.)

By these special telegraph wires the brain sees, the brain smells, tastes, and hears. And below this base of the brain, the brain ramifies principally *viâ* the spinal cord embedded in the backbones, all over the body, forming connections for feeling, moving, &c. Thus we obtain the conception of our central nervous system, our headquarters and field telegraph for the army of cells of which the living human being is composed.[1]

[1] Mr. Laing has so clearly described the apparatus by which we think and are brought in contact with the external world that we append his description. He says: "The mechanism by which correspondence is kept up between the living individual and the surrounding universe is very simple—in reality, as simple as that of an ordinary electric circuit. In the most complex case, that of man, there are a number of nerve-endings, or small lumps of protoplasm, embedded in the tissues all over the body, or highly specialized and grouped together in separate organs such as the eye and ear, from which a nerve-fibre leads direct to the brain, or to the spinal cord and so up to the brain. These nerve-endings receive the different vibrations by which outward energy presents itself, which propagate a current or succession of vibrations of nerve-energy along the nerve-fibre. This nerve-fibre is a round thread of protoplasm covered by a white sheath of fatty matter which insulates it like the wire of a submarine telegraph coated with gutta-percha. This nerve-wire leads up to a nerve-centre, consisting of two corpuscles of protoplasm: the first or sensory, a smaller one, which is connected by branches with the second, a much larger one, called the motor, from which a much larger nerve-fibre or wire proceeds, which terminates in a mass of protoplasm firmly attached to a muscle. Thus, a sensation is propagated along the sensory nerve to the sensory nerve-centre, whence it is transmitted to the motor-centre, which acts as an accumulator of stored-up energy, a large flow of which is sent through the large conductor of the motor-nerve to the muscle, which it causes to contract and thus produces motion. It is thus that the simpler involuntary actions are produced by a process which is purely mechanical. In the more complex cases, in which consciousness and will are involved,

Now, the fundamental facts to fix our minds on are these :—

Firstly, the greater the number of cells there are in the cortex of the brain, if they are healthy, providing they are properly connected up with the fibres of the nervous matter all over the body, the higher the mental power of the individual becomes.[1]

the process is essentially the same, though more complicated. The message is transmitted to the brain, where it is received by a cluster of small sensory cells or nerve-centres, which are connected with another cluster of fewer and larger motor-centres, often at some distance from them, by a network of interlacing fibres. But it is always a case of a single circuit of wires, batteries, and accumulators, adapted for receiving, recording, and transmitting one sort of vibrations caused by and producing one sort of energy, and one only. The brain does not act as a whole, receiving indiscriminately impressions of light, sound, and heat; but by separate organs for each, located in separate parts of it. It is like a great central office, in one room of which you have a printing instrument reading off and recording messages sent through an electric telegraph; in another a telephone; in a third a self-registering thermometer, and so on. And the same for the motor-centres and nerves. One set is told off to move the muscles of the face, another those of the arms, others for the legs and body, and so forth."—("A Modern Zoroastrian," S. Laing, 1895, p. 129.)

[1] "The extent of the convolutions is, therefore, a sure sign of the extent of intellect. They are more numerous and deeper in the European than in the negro; in the negro than in the chimpanzee; in the anthropoid ape than in the monkey or lemur. This grey nerve-tissue is the organ by which impressions from without are turned into perceptions, volitions, and evolutions of nerve force. The white matter is simply the medium of transmission, or we may say the telegraph wires by which the impressions are conveyed to the head office and the answers sent. The cell-tissue of the grey matter is thus emphatically the organ of the mind. In fact, if it did not sound too materialistic, we might call thought a secretion of the grey matter, only in saying so we must bear in mind that it is only a mode

Secondly, if by a hurt, i.e. concussion, disease, &c., damage is done to these cells, or even by pressure, the mental power of the individual is effaced or aberrated, according to the extent of the damage.[1] This condition, if it is complete, so long as it lasts, is a mental death: mind and soul cease to exist.[2]

of expressing the fact that the two invariably go together."—("A Modern Zoroastrian," S. Laing, 1895, p. 128.)

[1] "So far as science gives any positive knowledge as to the relations of mind to matter, it amounts to this: That all we call mind is indissolubly connected with matter through the grey cells of the brain and other nervous ganglia. This is positive. If the skull could be removed without injury to the living organism, a skilful physiologist could play with his finger on the human brain, as on that of a dog, pigeon, or other animal, and by pressure on different notes, as on the keys of a piano, annihilate successively voluntary motion, speech, hearing, sight, and finally will, consciousness, reasoning power, and memory."—("A Modern Zoroastrian," S. Laing, 1895, p. 140.)

[2] "The highest activities of the animal body, the wonderful manifestations of consciousness, the complex phenomena of the activities of thought, have their seat in the fore-brain. It is possible to remove the great hemispheres of a mammal, piece by piece, without killing the animal, thus proving that the higher mental activities, consciousness and thought, conscious volition and sensation, may be destroyed one by one, and finally entirely annihilated. If the animal thus treated is artificially fed, it may be kept alive for a long time; for the nourishment of the entire body, digestion, respiration, the circulation of the blood, secretion, in short, the vegetative functions, are in no way destroyed by this destruction of the most important mental organs. Conscious sensation and voluntary motion, the capacity for thought and the combination of the various higher mental activities, have alone been lost"—("The Evolution of Man," Prof. Ernst Haeckel, 1883, vol. ii. p. 225). "The functions of most of the parts of the brain which lie in front of the medulla oblongata are, at present, very ill understood; but it is certain that extensive injury, or removal, of the cerebral hemispheres puts an end to intelligence and voluntary movement, and leaves the animal in the

Thirdly, if any of the trunk system is injured below this centre near the base of the brain, the individual becomes a living death, that is, the whole body loses sensation, it cannot feel, it has no power of movement, but the brain thinks.[1]

condition of a machine, working by the reflex action of the remainder of the cerebro-spinal axis." . . . "There is no doubt that a molecular change in some part of the cerebral substance is an indispensable antecedent to every phenomenon of consciousness."—("Lessons in Elementary Physiology," T. H. Huxley, F.R.S., &c., 1893, pp. 299, 300.)

For much clearly-interpreted information see this work, Lesson XI.

"There can be no doubt that the cerebral hemispheres are the seat of powers, essential to the production of those phenomena which we term intelligence and will; and there is experimental and other evidence which seems to indicate a connection between particular parts of the surface of the cerebral hemispheres, and particular acts."—(*Idem*, p. 300.)

"Now it is certain that the will, like life, memory, consciousness, and other mental functions, is, so far as human knowledge extends, indissolubly connected with matter and natural laws, in the form of certain motions of the cells which form the grey substance of the nerves and of the nervous ganglia of which the cortex of the brain is the most considerable. This is conclusively proved by experiment. We know that, by removing certain portions of the brain of a dog or of a pigeon, we can destroy the power of motion while preserving the will, and by removing certain other portions we can destroy the will while preserving the powers of motion. Take away a certain portion of the brain of a pigeon, and although it retains the power of taking food, it has so totally lost the will to exercise this power that it will starve in the midst of abundance, though it can be kept alive by placing the food in its mouth. In like manner, in the human brain there are certain portions which, if destroyed by injury or disease, will paralyse the power of giving effect to the will by muscular movements, while the destruction of other portions will paralyse the will which originates such movements."—("A Modern Zoroastrian," S. Laing, 1895, p. 191.)

[1] "We do not feel pain in the place injured, but in the brain. If a

And lastly, when the brain sleeps, that is, when it has a smaller supply of blood, when chemical reaction

nerve of sensation be divided in its course to the brain, all the parts which are supplied by it lose their sensibility—for no other reason than that the conducting of the impression to the brain is no longer possible. Every man who has no knowledge of physiological processes, believes the feeling of hunger to be in the stomach. This is not so, the brain alone makes us conscious of the feeling. If the nerve uniting brain and stomach be divided, hunger is at an end, nor does it return. Neither does anger arise in the liver, or courage in the chest, but in the brain only. The heart, to which in common language so many feelings are ascribed, has nothing whatever to do with mental actions. It is nothing but a hollow muscle, which propels the blood. That mental feelings are indicated by its more or less frequent pulsations is caused by the mediation of a nerve, which connects heart and brain. This sympathy ceases with the destruction of the nerve. We see not with the eye or the optic nerve, but with the brain. If the optic nerve be divided, seeing is at an end." . . . "There have been a few instances of men in whom, by some accident, a dislocated cervical vertebra compressed the spinal cord in such a manner that the connection between the brain and the body was severed. Respiration and pulsation continued, however, and with them the nutrition of the brain. Such a state is a living death. The whole body is perfectly insensible and motionless—a corpse; the head only lives, with its immediate adjoining parts. The intellect, however, remains in such persons intact; they are living corpses."—("Force and Matter," Dr. Louis Büchner, 1864, pp. 143-147.)

"That the spinal cord as a whole is a nervous *centre* admits of very simple proof, on the lower and on the higher animals, and on man. A decapitated frog having lost brain and bulb, reacts by movements when the skin is pinched, and no longer reacts when the spinal cord is destroyed. A man whose spinal cord is cut, say in the dorsal region, by disease or by mechanical injury, reacts by movements of his lower limbs when the soles of his feet are touched, and he bears witness to the fact that he feels nothing, that he is not conscious of any impression, i.e. that the reaction of the spinal cord is carried out without sensation. Such reactions are instances of

is reduced, i.e. the brain receives less Ether, or as it is generally called, the temperature is lowered, we are unconscious, the brain is passive, we mentally die during the time of perfect sleep.[1] Moreover, when the brain is in a partial state of irregular activity, we dream. It is temporary madness. Some men live in this condition, through abnormal conditions of the brain, and we call them mad.

Now, there are two important points to be observed. First, the fibres from the cortical part of the brain converge to a centre technically called the *medulla oblongata* or *spinal bulb*.[2] And the second very im-

reflex action in the original and restricted sense of the expression; they are simple, immediate, fatal and unfelt responses to unfelt peripheral stimuli."—("An Introduction to Human Physiology," A. D. Waller, M.D., F.R.S., 1896, p. 482.)

[1] "Sleep, on the contrary, is a negative state—one in which these processes are reversed. The brain is inactive; consciousness and volition are in abeyance; coincidently the central blood-supply is diminished, the brain is smaller in size, and its temperature is lowered."—("Chambers's Encyclopædia," article "Sleep," 1892.)

"The state of the cerebral circulation during sleep has been the subject of some debate; opposite opinions have been advanced, to the effect that the brain is anæmic, or that it is congested. Although there is no doubt that in coma—a pathological state similar in some respects to physiological sleep—the cerebral vessels are congested, the observations of Durham on the exposed cerebrum of sleeping dogs, and of Jackson on the retinal vessels of sleeping infants, are to the effect that vessels shrink in sleep, and we may therefore feel reasonably assured that the sleeping brain, in common with other resting organs, receives less blood than in its state of activity."—("An Introduction to Human Physiology," A. D. Waller, M.D., F.R.S., 1896, p. 570.)

"It has been found further that the heat-production is least during sleep, greatest during muscular exertion."—(*Idem*, p. 283.)

[2] The immediate cause of death is always the stoppage of the functions of one of three organs; the cerebro-spinal nervous centre,

portant point to observe is: that although the mature brain has almost an infinite number of cells to produce the most complex thought, yet the human being is only able to bring a few of these cells into operation at the time. We think of only one thing at the time, and perform one action at the time involving the power of the will and this is our common experience.[1] It is when external conditions require us *to try to think* of more than one thing at the time we experience the

the lungs, or the heart. Thus, a man may be instantly killed by such an injury to a part of the brain which is called the *medulla oblongata* . . . as may be produced by hanging, or breaking the neck."—("Lessons in Elementary Physiology," T. H. Huxley, LL.D., F.R.S., 1895, p. 19.)

"Destruction of the spinal bulb at once arrests the movements of respiration; and provided the bulb be left intact, destruction of the brain does not abolish these movements. This of itself is enough to show that the spinal bulb includes the chief respiratory centre, even though it is not possible to define the centre anatomically as this or that nucleus of grey matter."—("An Introduction to Human Physiology," A. D. Waller, M.D., F.R.S., 1896, p. 148.)

"The regulation of the vascular system is administered by the central nervous system, viz. the medulla oblongata or spinal bulb, and the spinal cord, from which the vascular and cardiac nerves take origin, the particular parts from which they spring being spoken of as their 'centres,' and comprising (1) the vagus centre in the bulb, (2) the accelerator centre in the cord, (3) the principal vasomotor centre in the bulb, (4) accessory vasomotor centres in the cord. The mode of action of these centres has been experimentally examined by observing, (*a*) the consequences of their destruction or direct stimulation, (*b*) the consequences of stimulation of afferent nerves before and after destruction of the bulb or cord."—(*Idem*, p. 110.)

[1] "When our attention is brought to bear forcibly on a thing we think for the moment of nothing else, and every one knows that if we are absorbed by interesting reading others may talk around us while we do not hear them."—("Alterations of Personality," Alfred Binet, 1896, p. 141.)

sensation of worry—the thinking power gets weakened, and we have one of the most prolific sources of disease in modern times brought on by the high pressure we are ever sustaining.

All these evidences tend to show that some day the specialist will find in that intricate structure, the human brain, a highly complex switch, by which we are able to switch on and switch off connections from *a centre* with the mass of cells of which the outer brain is composed. And this centre is most delicately poised.[1]

Marvellously complex, marvellously mechanical, perfectly in harmony with chemical and physical reactions—a marvel of marvels, a miracle of miracles. Such is the human brain—an instrument on the proper use of which depends, in great part, human happiness or human misery.

The fundamental reactions giving thought, perception, feeling, self-consciousness, soul, mind, and so forth, are all physical reactions, the great factor is the current of Ether to cause the so-called chemical reactions. This is the verdict of Biological science.[2]

[1] "It is the central organ of the respiratory movements, and of other important functions, and an injury to it immediately causes death, whereas the large hemispheres of the fore brain (or the organ of the 'soul,' in a restricted sense) can be removed bit by bit, and even completely destroyed, without causing the death of the vertebrate animal—only its higher mental activities disappearing in consequence." —("The History of Creation," Ernst Haeckel, 1892, vol. i. p. 350.)

[2] "The definition of the laws which have shaped, and are still shaping, the course of progress in human society is the work of science, no less than it has been her work to discover the laws which have controlled the course of evolution throughout life in all the lower stages. But the spirit in which she has addressed herself to

We will now attack the problem in a somewhat different way, even though it may involve some repetition. We shall avail ourselves of that most interesting and important work by Messrs. Geddes and Thomson, "The Evolution of Sex."[1] We must not allow sentimental or prudish ideas to prevent our approaching the problem fearlessly—*the issues are too serious for this.*[2]

Everyone is aware that in Organic Nature the almost uniform fact is: There must be two sexes, male and female, in order to have a development of an offspring —*but not always*, indeed, in the lower forms of life the

the one task is widely different from that in which she has undertaken the other. To her investigations in biology, science has brought a single-minded devotion to the truth, a clear judgment, and a mind absolutely unfettered by prejudice or bias."—("Social Evolution," Benjamin Kidd, 1895, p. 19.)

This statement is literally true, and curiously enough this department of science seems the exception in its aims. Not so physical science; this department has largely given itself up to commercial enterprise; useful as it is, it is not however the highest aim of science. How biologists wish for the help of the physicist can hardly be better expressed than in the following words:— "Berthold's book on 'Protoplasmic Mechanics,' shows how the biologist persistently seeks the aid of the student of physics in his endeavour to explain the architecture of the living organism."—("The Evolution of Sex," Prof. Geddes and Thomson, 1889, p. 223.)

It is to be hoped that pages 53 to 67 in this work have successfully put in this link the biologist so earnestly desires.

[1] London: published by Walter Scott, 1889. This work is a vast compilation from many observers, and is written more free from technical words than usual.

[2] "It is customary to mark off the reproductive and sexual functions as facts altogether *per se*. Modesty defeats itself in pruriency, and good taste runs to the extreme of putting a premium upon ignorance."—("Evolution of Sex," p. 127.)

male sex is sometimes non-existent or not always necessary for development of the offspring.

Of the origin of sex we know but very little, that is to say we have very vague ideas of the reasons why a being is born male or female.

In the ovaries or two sacks of eggs are evolved in the female, cells—called eggs, but there are organisms—cells —formed in the male which perform, generally, most important functions in the perfect development of the individual.

We have seen that when the ripe egg starts from the ovary of the female, one of two results takes place, either it goes to waste, that is dies, or it is, as it is called, "fertilized" by one of the male cells, and generally only *one* out of thousands, from the male.

This one enters into the egg, passing through its envelope, and there, if one may use the expression, it melts in the yelk of the egg and alters the constitution of the yelk. We do not know what are the functions of this uniting of what is known as the germ and sperm, but it must be one of two reactions, either—

Without the male cell the egg runs to disintegration, just as a clock runs down without a pendulum; thus the male cell is a regulating force causing an orderly molecular rearrangement, or—

The male cell may be a group of molecules which when diffused in the yelk increases the energy of the molecular rearrangement, in fact it is a stimulator to development.

In either case the reaction is largely what is termed a "physico-chemical reaction," that is, the same molecular reaction which we find takes place in the so-called inorganic matter.

Very likely the former of the two views is correct,[1] because in some animals the division of the yelk takes place to a certain extent without fertilization; moreover, under certain conditions, in the lower organisms, development takes place without the fertilization by the male cell.[2]

Both the male cells and the female cells—or eggs, arise from a mass of molecules attracted together similarly as the molecules of quicksilver are attracted together, as a small drop or a bead of mercury is seen. The following is the essential nature of their development among animals generally: in the case of the female cell, the molecules roll themselves into a minute ball, and cover that ball with an envelope or shell. This is the first indication of the female cell—the egg. This egg, while its molecules are active, as a mass it is passive, that is to say, as a whole it is moved only by external forces. And so does the male cell commence in like manner, as a mass of free molecules, technically called protoplasm. Presently these molecules group themselves into an organized living creature, having a long tail, and it is by means of this tail, as it were, screwing itself through the fluid and thereby moving the organism (just the same mechanical principle

[1] Messrs. Geddes and Thomson tend to the opposite view. *Op. cit.* p. 157.

[2] "An unimpregnated ovum may advance some little distance on the road to development, and thus lends support to the theory of *parthenogenesis*—i.e. the formation and development of ova in a female, without the intervention of a male parent."—("Carpenter's Principles of Human Physiology," 9th edition, 1881, p. 914. See also "Quain's Elements of Anatomy," vol. i. part 1, Embryology, 1892, p. 14.)

as when a steamer is moved by the propeller),[1] that this energetic, virile creature finds the female egg-cell, and penetrates the envelope. The egg is then said to be fertilized. And now marvellously complex molecular alterations take place—too complex to describe here.[2] The mature female cell—the egg, is frequently one of the largest, whilst the male cell is generally one of the smallest of animal cells. Both are formed of what is called protoplasm. And then if the womb be healthy and neither shock nor hindrance be given, the marvellous processes we have described take place, and ultimately a child is born. What miracle, ever stated to have existed, equals the wonderful processes in Nature we have described?

Now there are many important issues resulting from the consideration of the known facts.

Does the fertilization of the egg alone produce those remarkable similarities which we find the child often has to one or the other of the parents, and thus bring about the factor known as hereditary peculiarities, or rather do not these peculiarities arise from the food the growing organism is absorbing from the female? Mental impressions arise from the force or inherent energy of molecules, and the female is providing molecules to the growing embryo. May it not be more likely that the hereditary qualities have their origin in the mental impressions, or the peculiar organization of the female?

[1] "The Evolution of Sex," *op. cit.* p. 110.

[2] After describing some of these molecular or chemical alterations, *true physical processes*, Messrs. Geddes and Thomson state: "The above short sketch will show how intricate, and yet at the same time how orderly, are the intimate processes of fertilization."—("The Evolution of Sex," p. 148.) These molecular reactions have been called "*quadrille des centres.*"

The ancients seemed to be aware of this influence; thus, "The Greek women placed statues of Apollo or Narcissus in their bedrooms, that they might bear children as beautiful as those on whom they gazed. Such children they prayed the gods to give them; for the Greeks loved beauty to distraction, and regarded ugliness as sin."[1]

A serious question also arises thus. If fertilization is not absolutely necessary in lower organisms, is it also absolutely and invariably necessary in the higher organisms? If the egg could develop under normal conditions, that is, in the womb without fertilization, who could possibly believe the result? And yet eggs are known to develop to almost perfect creatures in other parts of the body than the womb, the inherent power to develop to a mature creature being arrested solely by the external conditions being unsuitable to permit such development. Thus eggs are in rare cases developed to a very great extent in the body of the human *male* under conditions which seem to preclude fertilization.

Two remarkable cases of this sort exist in the College of Surgeons' Museum. One is of great interest. It is that of a young man about sixteen years of age bearing a *female* fœtus. And this is not such an uncommon case.[2] Such cannot be a case of "true" twins, that is two individuals developing from one egg or ovum, where part of the egg has remained dormant in the body of the male, and then suddenly began (in the case cited), after sixteen years lying dormant, to develop and try to

[1] "The Martyrdom of Man," Winwood Reade, 13th edition, 1890, p. 73.

[2] See the *Standard* newspaper, February 27th and 29th, 1896.

perfect itself by its own inherent power, because it is a fact "which holds without exception in the human species, that 'true' twins are of the same sex."[1]

Organic molecules, as they are called, in the more simple combinations, may reproduce their kind without the existence of an egg. The propagation of plants by cuttings is a fact. The lower organisms in the animal kingdom may be divided artificially into parts, and each part afterwards becomes a perfect organism. Instance the little organism often attached to chickweed—the Hydra.

And thus we see the marvellous power of molecules, always built up of atoms, to group themselves into ever-varying masses of *visible* matter, and amongst them is the material called protoplasm, which is an extremely complex and unstable molecular compound, undergoing continual molecular change; and this change can only go on at a certain definite temperature. This is an illustration of the importance of knowing what temperature means and what is meant by heat.

We have seen that the male cell—the sperm, and female cell—the egg, arise from naked cells, that is, cells not having a covering or shell, masses of free, moving molecules having the remarkable, ever-changing forms we have described. Now the blood has an enormous number of like organisms. Do these organisms bear any relation to these male cells and female cells—the human eggs? We know that in the seas and lakes and rivers there teem such living objects, perfect individuals, having a definite life history, which multiply by dividing themselves, secrete shells, in fact, are

[1] "The Evolution of Sex," 1889, p. 39.

perfect living individuals. Moreover, some authorities are of opinion that these individuals do not, in the ordinary course, die.

Now let us sum up. All matter is built up of atoms which are eternal, indestructible; each species is eternally endowed with inherent powers. There is gradation in these physical powers. The highest known atomic power is that class of atom which is able to collect to itself atomic matter to form the highest or most complex form of molecule. The highest form of molecule has the power to attract and command the power of other molecules, and thus we have that marvellous mass of molecular matter we call the human being, and the life power of those molecules, its sum, is human life. Thus life is the sum of the activity or energy of molecules built up of atoms, but all is subordinate to the factor of factors—Ether, generally called Heat.[1]

[1] "Thus, then, we may take that mode of Vital Activity which manifests itself in the Evolution of the germ into the complete organism repeating the type of its parent, and in the subsequent maintenance of that organism in its integrity,—in both cases at the expense of materials derived from external sources,—as the most universal and the most fundamental characteristic of Life; and we have now to consider the nature and source of the Force or Power by which that evolution is brought about. The prevalent opinion has until lately been, that this power is inherent in the germ; which has been supposed to derive from its parent not merely its material substance, but a . . . *germ force*, in virtue of which it builds itself up into the likeness of its parent, and maintains itself in that likeness until the force is exhausted, at the same time imparting a fraction of it to each of its progeny. . . . When we carefully look into the question, we find that what the *germ* really supplies is not the force, but the *directive agency*; thus rather resembling the control exercised by the superintendent builder who is charged with the working-out the

In all these wonderful complex arrangements of cells and material secreted by cells, in these functions of cells which we call life, there are molecular conditions which produce health, and sensations termed comfort, intelligence, pleasure, happiness, &c. Also conversely there are molecular conditions which produce disease, and sensations termed discomfort, non-intelligence, unhappiness, misery. *Obviously it should be the aim of man to cause regeneration under conditions which promote the former and tend to destroy the latter.* This is quite within the reach of human power directly the object to be aimed at is clearly seen, and not before.[1]

Many may be tempted to regard such an aim as

design of the architect, than the bodily force of the workmen who labour under his guidance in the construction of the fabric. The actual constructive force, as we learn from an extensive survey of the phenomena of life, is supplied by Heat; the influence of which upon the rate of growth and development, both Animal and Vegetable, is so marked as to have universally attracted the attention of Physiologists; who, however, have for the most part only recognized in it a *vital stimulus* that calls forth the latent power of the germ, instead of looking upon it as itself furnishing the power that does the work."—("Carpenter's Principles of Human Physiology," 9th edition, 1881, pp. 4, 5.)

[1] "Plague, pestilence, and famine are admitted, by all but fools, to be the natural result of causes for the most part fully within human control, and not the unavoidable tortures inflicted by wrathful Omnipotence upon His helpless handiwork."

"Harmonious order governing eternally continuous progress—the web and woof of matter and force interweaving by slow degrees, without a broken thread, that veil which lies between us and the Infinite—that universe which alone we know or can know; such is the picture which science draws of the world, and in proportion as any part of that picture is in unison with the rest, so may we feel sure that it is rightly painted."—("Lay Sermons, Addresses, and Reviews," Thos. H. Huxley, LL.D., F.R.S., 1893, p. 246.)

hopeless; they may say all Nature is cruel, and man must of necessity be cruel to be in harmony with Nature. Life exists by life living on life. This is quite true, but we must also remember that it is only in the very highly organized creature—man, that the sensations of the higher feelings are well marked, resulting from his complex nervous formation. There is no evidence of a like appreciation of pain existing in the lower creation. "See, for instance, in this connection, Mr. Alfred Russel Wallace's remarks on the ethical aspect of the struggle for existence (*Darwinism*, Chap. ii.). He gives examples in support of the opinion that the supposed sufferings caused to animals by the struggle for life have little real existence; they are rather the reflections of the imagined sensations of cultivated men and women in similar circumstances." [1]

[1] "Social Evolution," Benjamin Kidd, 1895, p. 42.

STATEMENT No. 14.

The power of the regeneration of molecules causes regeneration of cells, and this causes regeneration of Life. Life is Eternal.

Let us fully grasp the point we have arrived at. Atoms are indestructible. The grouping of atoms is perpetually altering. All is in a state of change, and change only. The human body is built up of atoms, all in the molecular form. The evidence seems to tend to the view that while the life of the individual exists, or his cycle of change exists, all are under the control of a single atom. So long as this commander-in-chief can maintain the combination of the fundamental molecule, and the molecules can maintain the existence of the fundamental cell, and this cell can hold its community of cells together, we have the life of the individual. It is in a condition of strain. When this controlling power is lost, then the cellular matter disintegrates, and we have the phenomenon called death. And so delicate is this condition of strain, i.e. life, that given even a shock, a mental shock, which may have no apparently direct physical cause, and death sometimes ensues. Moreover, as this strain gets greater in age, mostly from the great human struggle for existence, the desire for life wanes and premature death takes place, which would not be the case if the condition of the organism were happier.

Now if science teaches one thing more absolutely than another, it is this fact of the regeneration of molecules. The whole science of chemistry is founded on it. If this regeneration ceased, the science of chemistry would cease. The physical condition of *all* matter would be impossible.

Life therefore being the sum of the potentialities of atoms, and atoms being indestructible, life must be eternal, and after the disintegration of the mass, which we call death, inasmuch as the functions or potentialities of atoms are eternal—the re-combinations of atoms are eternal also. Regeneration is life. We can alter but we cannot die. The physical alteration is perpetually continuing, minute by minute, during the life history of the human being.[1] By the aid of photography we can take exact pictures of ourselves, and we do do it. Compare the picture of an infant with the youth, the youth with manhood, manhood with decrepit old age. How little there is in common. The whole is a series of transformations. The man of to-day is not the man of yesterday, and the man of to-

[1] "Even the most solid portions of the animal frame, such as the bones and (to a less extent) the teeth, are undergoing a perpetual although a slower change of this nature; and throughout the whole body there is a continuous removal of effete or worn-out tissues, and a corresponding deposition of new matter. Every blow we strike, every thought we think, is accompanied by the death and disintegration of a certain amount of muscular or nervous tissue as its necessary condition; and thus every action of our corporeal life, from its beginning to its close, takes place at the expense of the vitality of a certain amount of organised structure. This is termed *molecular death*, and, within its proper limits, is obviously essential to the life and well-being of the organism."—("Chambers's Encyclopædia," 1889, article "Death.")

morrow will not be the man of to-day. Certain brains of extra complexity give us our prominent men in whatever department of life it may be. We erect statues to their memory. The statue is only therefore a presentation of one phase of his life. When shall we say it is the copy of the man? We generally take it at the last phase of existence. Take an illustration. There is a fine statue of Darwin at the South Kensington Museum. Why is Darwin represented as the old man? Why not represent the infant?—this was Darwin, or the schoolboy—this again was Darwin, or the man in his very prime of life—for this also was Darwin. If we would do Darwin justice, there should be perhaps thousands of statues, and all these would be copies of Darwin!

As the changes are in the external body, so are they in the internal, so also are they in the brain. The thinking organs, the brain-cells, are always changing, and as they change our minds change. The mind of the infant does not exist.[1] It is the result of the slow alteration of a material substance; and as it alters from day to day, so does its mind grow and alter, hour by hour, day by day. The child does not

[1] "We all know that the new-born child has no consciousness, no knowledge of itself and of the objective world. Whoever has children of his own, and follows their mental development candidly, cannot possibly deny that processes of biological evolution are at work there. Just as all other functions of the body develop in connection with their organs, so does the mind develop in connection with the brain. And this gradual development of the child's mind is such a wonderful and beautiful phenomenon, that every mother and every father with eyes to see takes unwearied delight in observing it."—("The Evolution of Man," Professor Ernst Haeckel, 1883, vol. ii. p. 452.)

reason as the man does, and the mentally mature man thinks differently from the immature man.[1] All these facts are notorious. They are not new. How true is the saying, "When I was a child I spake as a child, I understood as a child, I thought as a child; but when I became a man I put away childish things." Science did not exist at the time when the disciple of Jesus Christ uttered these pregnant words. He could not know that it was the slow organic alterations in the brain which produced the differences of thought and action. Then we looked through a glass darkly; but to-day, through the light of science, we see clearly.[2]

The power of regeneration always depends on that subtle fluid we can now see, and the effects of which we can trace, and we call the fluid *Ether*. Any other

[1] "Even in the course of our normal life a great number of distinct personalities succeed one another. It is by an artifice that we connect them into one; for after twenty years' time we no longer have the same feelings or judgments as at the beginning of the period."—("Alterations of Personality," Alfred Binet, 1896, p. 261.)

[2] "With regard to the human 'soul-organ,' the brain, the application of the fundamental law of biogeny has been finally established by the most careful empiric observations. The same may be said of its functions, the 'activity of the soul.' For the development of a function goes hand in hand with the gradual development of every organ. The morphological differentiation of the various parts of the brain corresponds with its physiological separation, or 'division of labour.' Hence, what is commonly termed the 'soul' or 'mind' of man (consciousness included), is merely the sum-total of the activities of a large number of nerve-cells, the ganglia-cells, of which the brain is composed. Where the normal arrangement and function of these latter does not exist, it is impossible to conceive of a healthy 'soul.' This idea, which is one of the most important principles of our modern exact physiology, is certainly not compatible with the widespread belief in the 'personal immortality' of man."—("The History of Creation," Professor Ernst Haeckel, 4th edition, 1892, vol. ii. p. 494.)

name will do for it. In it and by it we live and move and have our being. Ever present, eternal and omnipotent, we may if we like call this Ether—God, a God not to be praised, prayed to and flattered, but to be known and OBEYED. It follows, so long as the components of this world are as they are, and the fluid Ether circulates amongst those components, life will be always regenerating. We are born and re-born. We were born and re-born. We shall be born and re-born. And at a rate so fast that from death to re-life is a relatively short interval of time. For remember we live in eternity.[1]

The answer comes—we have individually no idea of having been re-born—the past is oblivion.[2] This is true. But we know we were *once* born—no human

[1] "We have long known, even from the structure of the stratified crust of the earth alone, that its origin and the formation of neptunic rocks from water must have taken, at least, several millions of years. From a strictly philosophical point of view, it makes no difference whether we hypothetically assume for this process ten millions or ten thousand billions of years. Before us and behind us lies eternity."—("The History of Creation," Prof. Ernst Haeckel, 1892, vol. i. pp. 132.)

"We can as little imagine a *first beginning* of the eternal phenomena of the motion of the universe as of its final end." . . . "The universe is unlimited and immeasurable in both space and time. It is eternal, and it is infinite. Nor can we imagine a beginning or end to the uninterrupted and eternal motion in which all particles of the universe are always engaged. The great laws of the *conservation of force* and the *conservation of matter*, the foundations of our whole conception of nature, admit of no other supposition."—(*Idem*, p. 398.)

[2] "We talk of immortality, but what we were before we were born, or what we shall be after we die, what soul, consciousness, personal identity, really are, how they came to be indissolubly connected with matter, and what they will be when that union is dissolved, are mysteries as to which we can only make guesses, like the Brahmins and Buddhists, whose guess is transmigration, or the Red Indians, whose guess is a happy hunting-ground beyond the setting sun."—("Problems of the Future," S. Laing, 1894, p. 194.)

being recollects his birth. And even most of the phenomena of life we forget. "How many things are afterwards forgotten over which we have spent much time at school, but of which we make no practical use in after life!" It would seem, in the main, this is the order of things: the brain-cells have the power of reproducing their kind, or their arrangement, but they more often fail to reproduce. If they reproduce we have memory, if they fail we have loss of memory.[1] What individual could describe that which he had for dinner on a certain day a few years ago, unless some special incident fixed the fact in his mind? Yet probably a full half-hour of his life was allotted to this work of eating!

"A young artist may spend hours, even days, over a picture, and then forget all about it to such a degree as to make the sight of it, after a long lapse of time, perfectly new to him; that is to say, he will not recognize it as anything he has previously seen. Such, however, is the fact; and it is no less true that artists

[1] "The brain matter undergoes, no doubt, a constant change, but the *mode of its combination* which determines individual consciousness ever remains the same. That this modification is both inexplicable and incomprehensible, proves nothing against the fact itself. Who can explain why certain morbid conditions are transmitted to the third instead of the second generation? Is not such a phenomenon more wonderful than the connection of brain and memory? Yet no rational physician doubts that it can only be the result of material conditions, the laws of which are, and probably will ever remain, unknown to us."—("Force and Matter," Dr. Louis Büchner, 1864, p. 131.)

"It would seem as if the brain were like a very delicate photograph plate, which takes accurate impressions of all perceptions, whether we notice them or not, and stores them up ready to be reproduced whenever stronger impressions are dormant and memory by some strange caprice breathes on the plate."—("A Modern Zoroastrian," S. Laing, 1895, p. 135.)

have been known to repudiate pictures afterwards conclusively proved to be authentic, with consequences unpleasant to themselves." [1]

And we shall see in this process of regeneration what a blessing it is for us all that this power of memory does not cling too closely to us. We do not wish our errors to stick too closely to us. The actions of men are mainly governed by the condition of the brain-cells. These objects, which are thinking, living individuals, prompt our every-day actions. They create the savant, they make the madman. They are the factors in the existence of the thief as well as the most honest of men. They make the truthful and the liar, the saviour and the murderer. They make the hero and the coward. In every case they are the prompters of our every-day actions in life. They compel the wise to think wisely, and the foolish to think foolishly. *They make misery and human happiness.*[2]

The brain-cells are to be cultivated and marshalled in order. This is education. They exist in exceptional cases in a natural intuitive development, partly

[1] "My Autobiography," W. P. Frith, R.A., 1887, vol. ii. p. 315.

[2] "If there is one thing clear about the progress of modern science, it is the tendency to reduce all scientific problems, except those which are purely mathematical, to questions of molecular physics—that is to say, to the attractions, repulsions, motions and co-ordination of the ultimate particles of matter. Social phænomena are the result of the interaction of the components of society, or men, with one another and the surrounding universe. But, in the language of physical science, which, by the nature of the case, is materialistic, the actions of men, so far as they are recognizable by science, are the results of molecular changes in the matter of which they are composed; and, in the long run, these must come into the hands of the physical. *A fortiori*, the phænomena of biology and of chemistry are, in their ultimate analysis, questions of molecular physics. Indeed, the fact is acknowledged by all chemists and biologists who look beyond their immediate occupations."—("Lay Sermons, Addresses, and Reviews," T. H. Huxley, LL.D., F.R.S., 1893, p. 144.)

independent of education, and only partly. Such are called men with innate ideas.[1] And when such men

[1] "Taking a series of human brains, and comparing the convolutions of uncivilised and civilised men, of men distinguished by abilities much above or much below the average, a general relation is traceable between complexity of surface and degree of intelligence. The basal ganglia are identical in the two cases, but the higher brain is more richly convoluted, its sulci are more numerous; the lower brain is simpler, its sulci are less numerous; the latter is practically a simplified diagram of the former; the effect of the difference is that the total area of grey matter is greater in the more highly than in the less highly organised brain. This is all we know with regard to the relation between quality of organ and quality of function; finer and more impalpable relations doubtless exist, but have not been demonstrated; the very absence of anatomical difference in the brains of average and of exceptionally able men leaves us, however, free to think, and justified in believing, that beyond quantity of grey matter there are differences in its quality. Perhaps its cells are more numerous, perhaps these more numerous cells are of better quality in the brains of the exceptionally able; but no microscopical or chemical proof has been given for or against such suppositions, still less is there any physical evidence available to distinguish the brain matter of 'good' men from that of 'bad' men."—("An Introduction to Human Physiology," A. D. Waller, M.D., F.R.S., 1896, p. 522.)

"The total number of nerve-cells in the human brain has been estimated at 2,000 millions."—(*Idem*, p. 528.)

"The brain, or, more precisely speaking, the cortex of the brain, is the organ of intelligent sensation and motion. Taken in the rough, the intellectual rank of animals bears some relation to the weight of the brain. Thus the average ratio between brain-weight and body-weight is in round numbers:—

In fishes . . .	1 to 5,000
„ reptiles . . .	1 to 1,500
„ birds . . .	1 to 220
„ mammals . . .	1 to 180
„ ourang . . .	1 to 120
„ man . . .	1 to 50

But mere weight of brain is not a regular index of degree of in-

are born, and their ideas are favourable for progress, and men are ripe for progress, then such men are the leaders of men.[1]

The consideration of this conception of human regeneration—the regeneration of the "*ego*," is most important. The conception of the perpetual present produces an entirely new order of thought. When we get this fundamental idea there is a clear trumpet-like voice, ringing through all Nature, asking the individual, "What are you doing to forward the happiness of your fellow creatures, *and of your own prospective happiness?*" Are you carrying out the fundamental ethical law; that is: are you doing unto others as you would be done by, or are you doing your level best to over-

telligence in individual cases; there are many exceptions to the general rule.

"As regards man, very similar considerations hold good, viz. taken in the rough, the brain-weight of distinguished men is above, while that of idiots is below the average, and the brain-weight of civilised men is above that of savages. Yet there are many individual exceptions to the general rule."—(*Idem*, p. 521.)

[1] "To put it in the words used by Professor Flower in speaking of human society, 'Progress has been due to the opportunity of those individuals who are a little superior in some respects to their fellows, of asserting their superiority and of continuing to live and of promulgating as an inheritance that superiority.' The recognition of this law must be the first step towards any true science of society; and it is only right that we should find Professor Flower insisting, although such a spectacle is somewhat unusual at present amongst exponents of biological science, that it is 'the message which pure and abstract biological research has sent to help us on with some of the commonest problems of human life.' Where there is progress there must inevitably be selection, and selection must in its turn involve competition of some kind."—("Social Evolution," Benjamin Kidd, 1895, p. 37.)

reach your fellow creature and to try to make him your slave? For slavery exists now as of old, it has only altered its phase. If you will not be my servant, says the unprincipled capitalist, then starve, and so may your children. And how does this question operate in all political, commercial, social, domestic affairs? New views immediately crop up one by one.

Now we have the conception of an atom—*a gaseous atom*[1]—wafted to and fro by the wind. It finds its suitable habitation—the ovary, and then of *its own inherent powers* it slowly accumulates to itself molecular matter, vastly complex, to be ultimately a thinking, feeling, self-conscious organism, and we call it a Man. A man with a soul. A soul which ceases to exist when the brain ceases to be active—this is undoubted.

More than this, the tendency of modern science shows that this central object which never dies, which regenerates molecular matter, is a gaseous object Put some water under the exhausting air-pump, rarefy the air and notice the little tiny air bubbles collecting at the bottom of the water, and ascending through the water. Gaseous bodies tend always to get to their habitat the gaseous envelope which surrounds the solid and liquid constituents of the earth. We know that alterations of atmospheric pressure take place hour by hour, tending to carry gaseous molecules from beneath the earth to the surface of the earth. We know that when our bodies are buried, the order of regeneration of life becomes in death inverse, the solid becomes in great part gaseous, but try our best the gaseous does not

[1] The reverting of the organic solid and liquid organic matter into the gaseous, may often be seen in a dead dog lying on the sea shore. It is blown out with the accumulating gases.

remain where we placed the dead body.[1] In all fossil remains, the soft parts are obliterated ; they have been altered into the liquid or gaseous, and so complete are the molecular reactions in fossils that the entire original substance has in many cases been removed. Not a muscle nor a nerve has ever yet been discovered in a fossil, although by molecular displacement copies of the soft parts are sometimes retained. Where have these soft structures gone? The above answer is the *only* conceivable one. While if we burn the body, the transformation only takes place more quickly. These are facts, undoubted facts. See how they operate in the conception we are now imbibing, even to account for a few of the physical operations in Nature. The oxygen exhaled by the vegetable, the re-combination in the animal body, the carbonic acid gas given out by the animal and re-absorbed by the vegetable, and the re-secretion of the carbon by the vegetable, again the re-exhalation of the oxygen—these are processes of re-generation. To

[1] "In the compact substance of a femur that had been long buried, Aeby found only 16·5 per cent. of animal matter."—("Quain's Elements of Anatomy," vol. i. part 2, Histology, 1893, p. 254.)

"Whether in the free atmosphere, or under the earth, which is always more or less impregnated with air, all animal and vegetable matters end by disappearing. To arrest these phenomena an extremely low temperature is required. It is thus that in the ice of the Polar regions antediluvian elephants have been found perfectly intact. The microscopic organisms could not live in so cold a temperature. These facts still further strengthen all the new ideas as to the important part performed by these infinitely small organisms, which are, in fact, the masters of the world. If we could suppress their work, which is always going on, the surface of the globe, encumbered with organic matters, would soon become uninhabitable."—("Louis Pasteur, His Life and Labours," 1885, p. 65.)

account for the facts of Nature, these processes must be incessant and going on at an enormous rate. All organic bodies, say the human body, regenerate very quickly.[1] Let us say that the whole of the body only regenerates in six months. Let the individual be a mean in his lifetime, of four cubic feet. Let his life be, say, fifty years. His life history would consist of a mass of molecular matter equal to 400 cubic feet. Now add this conception to the calculation made by Sir John Herschell, page 90, and where can figures possibly come in to account for the regeneration which is an obvious, eternal, and very quick differentiation of molecular matter?

We shall presently consider the operations of the organic whole, the always present mass of molecules, which we call—the Man, in his political, social, and domestic actions, and more especially in his international actions.

[1] "With every breath which issues from our mouth, we expire a portion of the food we eat, and of the water we drink. We change so rapidly, that we may be said, after a lapse of four weeks, to be different and new beings; the atoms are exchanged, but the mode of their combination remains the same. The atoms are in themselves unchangeable and indestructible; to-day in this, to-morrow in another form, they present by the variety of their combinations the innumerable forms in which matter appears to our senses. All this while the number of atoms in any element remains on the whole the same; not a single particle is formed anew; nor can it, when formed, disappear from existence. Proofs innumerable can be adduced to this effect. Dissolution and generation, growth and decay, proceed everywhere hand in hand—an eternal chain. With the bread which we eat, the air we respire, we attract the matter which has formed the bodies of our ancestors thousands of years ago; and we return a portion of our bodies to the external world, in order shortly after to receive it again."—("Force and Matter," Dr. Louis Büchner, 1864, p. 11.)

15.

SUMMARY OF THE PREVIOUS STATEMENTS AND PROOFS.

The Factors in Human Life—The Issue.

We have now arrived at a position when we can summarize the facts and understand the factors in human life.

Firstly. All matter is built of atoms which are never destroyed, were never created—they are eternal.

Secondly. Atoms form molecules. The atoms which form molecules are eternally regenerating molecules.

Thirdly. There are differences in potentialities of atoms—hence we obtain a higher and higher grade of molecule.

Fourthly. All living creatures, except the very lowest forms, are built up of cells and the secretions of those cells. All cells are built up of molecules. In the higher animals, including man, the cells are controlled by the central molecule, which is in its turn controlled by the fundamental atom.

Fifthly. In man one of those controlling centres exists, and so long as this cell—the commander-in-chief of the army of cells, called the human organism, can keep its army together we have what we commonly call life or that species of life we call the life of the being. So soon as this controlling power ceases what we call death takes place.

Sixthly. The result of death is decomposition of the matter of the body—the army of cells is dispersed, mostly converted into gases, and is distributed or tends to be distributed in the envelope surrounding the earth—the air.

Seventhly. From principally the air, the specific atom, which forms the initial, fundamental molecule, again gets into the system of the human female, gathers to itself from the living organism the material to form the fundamental molecule, which is the initial formative power of the growing object—the human egg. And this egg by the process already described alters itself by adding to itself the material from the parent organism and thus forms the infant human being.

Eighthly. The human being therefore had a regenerated past life, is a regenerating life present, and will be a regenerated life future. Always terrestrial. As there are more specific atoms, which form human beings, than can combine at the same time to form organisms and live, it follows that more organisms are born than can survive.

Ninthly. No two organisms from the same parents are alike, hence there is a constant variation in individual organisms, and those best adapted to their surroundings tend to flourish—the others die—hence *the struggle for existence.*

Tenthly. The highest or most intelligent man differs from lower organisms in being able, amongst other things, to forecast his future, and to know that very vastly the happiness of his future, as also that of the present, is in his own hands.

Eleventhly. Herein lies the incentive for that proper conduct of the individual organism to produce that condition of things which tends to develop the maximum of human happiness for himself and others. To do this the selfish Ego must be suppressed, and the dominant object to aim at is: that condition of things which will produce the highest attainable happiness *for all which are born.*

Twelfthly. It is obvious such a scheme of Nature is not a national progress, but an international progress. Nature is cosmopolitan.

Thirteenthly. When we see the capacity of Nature to regenerate the human organisms, under conditions which the intellectual human being loathes, and under conditions which bar all hope—and from which often come our agitators, our criminals, our nihilists, &c.—then we see the necessity of forwarding the progress of the higher human development. And this development is just what Nature is forcing,[1] and man is now beginning

[1] "There is no phenomenon so stupendous, so bewildering, and withal so interesting to man as that of his own evolution in society. The period it has occupied in his history is short compared with the hole wspan of that history; yet the results obtained are striking beyond comparison. Looking back through the glasses of modern science we behold him at first outwardly a brute, feebly holding his own against many fierce competitors. He has no wants above those of the beast; he lives in holes and dens in the rocks; he is a brute, even more feeble in body than many of the animals with which he struggles for a brute's portion. Tens of thousands of years pass over him, and his progress is slow and painful to a degree. The dim light which inwardly illumines him has grown brighter; the rude weapons which aid his natural helplessness are better shaped; the cunning with which he circumvents his prey, and which helps him against

to grasp the fact—but this progress the religious world will not understand and thwarts.[1] Nature has decreed that ultimately the whole of

his enemies, is of a higher order. But he continues to leave little impress on nature or his surroundings; he is still in wants and instincts merely as his fellow denizens of the wilderness.

"We look again, after a comparatively short interval, and a marvellous transformation has taken place—a transformation which is without any parallel in the previous history of life. This brute-like creature, which for long ages lurked in the woods and amongst the rocks, scarcely to all appearances of so much account as the higher carnivora with which he competed for a scanty subsistence, has obtained mastery over the whole earth. He has organized himself into great societies. The brutes are no longer his companions and competitors. He has changed the face of continents. The earth produces at his will; all its resources are his. The secrets of the universe have been plumbed, and with the knowledge obtained he has turned the world into a vast workshop where all the powers of nature work submissively in bondage to supply his wants. His power at length appears illimitable; for the source of it is the boundless wealth of knowledge stored up in the great civilisations he has developed, every addition to this knowledge but offering new opportunities for further expansion."—("Social Evolution," Benjamin Kidd, 1895, p. 31.)

[1] "The fruits from the 'tree of knowledge' have ever been forbidden; and the priesthood, who fancied themselves alone in the possession of the truth, have ever carefully reserved these for their own benefit, and to the detriment of the rest of humanity. When Copernicus, three hundred years ago, did away with the geocentric delusion, and founded our present system of the universe, a storm of indignation arose, and the Church hurled the same anathemas against it, as it did thirty years ago when Darwin withdrew the last support from the anthropocentric delusion."—("The History of Creation," Prof. Ernst Haeckel, 1892, vol. ii. p. 470.)

"The essence of religion is inertia: the essence of science is change."—("The Martyrdom of Man," Winwood Reade, 13th edition, 1890, p. 34.

"I am firmly persuaded that whatever is injurious to the intellect is also injurious to moral life; and on this conviction I base my conduct with respect to Christianity. That religion is pernicious to the intellect; it demands that the reason shall be sacrificed upon the

the human race shall be one international family.[1] Man has only to decide how much suffering he elects to go through in order to retard this issue.

Now Religion is and has always been *ultra* rational —there has never been such a thing as a rational religion. This fact has been the cause of the power of the priests of all ages and denominations, for they live upon the *ultra* rational, that is ignorance.

But gathering the facts, as we are now doing, we are preparing the way, if not even formulating, the thing men are looking for—a rational religion or a religion founded solely upon facts.[2]

altar; it orders civilised men to believe in the legends of a savage race. It places a hideous image, covered with dirt and blood, in the Holy of Holies; it rends the sacred Veil of Truth in twain. It teaches that the Creator of the Universe, that sublime, that inscrutable power, exhibited his back to Moses, and ordered Hosea to commit adultery, and Ezekiel to eat dung. There is no need to say anything more. Such a religion is blasphemous and foul."—(*Idem*, p. 526.)

[1] "Civilised society is becoming one vast highly organised and interdependent whole—the wants and requirements of every part regulated by economic laws bewildering in their intricacy—with a nervous system of five million miles of telegraph wire, and an arterial system of railways and ocean steamships, along which the currents of trade and population flow with a rapidity and regularity previously unimagined. The old bonds of society have been loosened; old forces are becoming extinct; whole classes have been swept away, and new classes have arisen. The great army of industrial workers throughout the world is almost entirely a growth of the past hundred years."—("Social Evolution," Benjamin Kidd, 1895, p. 8.)

"The period through which we are passing is perceived to be one of transition. A definite, long-drawn-out, and altogether remarkable era in the history of our civilisation is coming to a close amongst the more advanced peoples."—(*Idem*, p. 243.)

[2] "The Monistic religion of Nature, which, accordingly, we must

This is the religion for which the liberal and enlightened priests wish as earnestly as the enlightened laymen. For priest and layman, royalty and subject, rich and poor, the intelligent and the idiot, the savant

consider as the true 'religion of the Future,' will not, like all Church religions, stand opposed to the rational knowledge of nature, but be in perfect harmony with it. And whereas Church religions are founded on deception and superstition, the religion of Nature will be based upon truth and knowledge." . . . "During the most flourishing period of the Middle Ages, when Christianity asserted its sovereignty over the whole world, the crudest ignorance, the most offensive barbarity, and the deepest immorality prevailed everywhere. Philosophy, the prince of all the sciences, which, five hundred years before Christ, had—in Heraclitus, Empedocles, and Democritus—sown the seeds for our modern theory of evolution, became, by the dissemination of Roman Catholic dogmas, and the burning piles of the Inquisition, the blind tool of ecclesiastical faith."—("The History of Creation," Prof. Ernst Haeckel, 1892, vol. ii. p. 498.)

"The highest function of the human mind is perfect knowledge, fully developed consciousness, and the moral activity arising from it. 'Know thyself!' was the cry of the philosophers of antiquity to their fellow-men who were striving to ennoble themselves. 'Know thyself!' is the cry of the Theory of Development, not merely to the individual, but to all mankind. And whilst increased knowledge of self becomes, in the case of every individual man, a strong force urging to an increased attention to conduct, mankind as a whole will be led to a higher path of moral perfection by the knowledge of its true origin and its actual position in Nature. The simple religion of Nature, which grows from a true knowledge of Her, and of Her inexhaustible store of revelations, will in future ennoble and perfect the development of mankind far beyond that degree which can possibly be attained under the influence of the multifarious religions of the Churches of the various nations,—religions resting on a blind belief in the vague secrets and mythical revelations of a sacerdotal caste. A firm foundation for this religion of Nature is formed by the monistic conviction of the unity of all natural phenomena, the unity of mind and body, of force and matter, of God and Universe."—(*Idem*, p. 497.)

and the fool, are all subject to the grand natural law—Regeneration, and when this law is recognized the inward eye sees the unity of things. The great difficulty in human progress is the difficulty for the individual to get away from pernicious systems. The systems are more at fault than the individuals.

From the standpoint we have taken we shall consider our surroundings and presently trace the social Evolution going on. We shall then be able to appreciate the grand drama in which *every individual is taking a part.*

PART III.

DEDUCTIONS DERIVED FROM THE ISSUE.

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I.

The History of Life.

THE READING OF THE GREAT STONE BIBLE.

Nature has written the history of this world in no uncertain terms. It is recorded in that wonderful Book of books, that wonderful Stone Bible interpreted by geological science. It is absolutely *The Bible.* It is not written by the hand of a man-like creature. It is written by the distribution of the forces, the innate forces of those objects we call atoms. It is written by Nature. If we like to deify Nature,[1] and call Nature—*God. It is written by God.*

Man sees and feels these natural forces, impelling him at every step, sometimes dreadful in their actions; he deifies them and calls the reactions the act of God. The savage, from his lowly brain organization, unable to rise to the higher generalizations of Modern Science, seeks to idolize these forces and gives them material forms;[2] hence we have the various forms of

[1] The word "Nature" may be defined in relation to the Earth, as matter, and the energies inherent in the atoms of which matter is composed.

[2] "The arithmetical arrangement of the gods depends entirely upon the intellectual faculties of the people concerned. In the period

idols,[1] fetiches, &c., and even in the higher religions of civilization there is only a difference in degree from the lower religions.

The history of this world may be summed up in the words: a continuous eternal system of molecular change, of molecular generation and regeneration. Science is unable, and probably will never be able, to trace the world to an origin; to do so with the present factors must be as hopeless as it is unnecessary.

It is thought, by some, that the molecules of which the earth consists, were once all in an incandescent gaseous condition, that is, the molecules were highly

of Thing-worship, as it may be termed, every brook, tree, hill, and star is itself a living creature, benevolent or malignant, asleep or awake. In the next stage, every object and phenomenon is inhabited or presided over by a genius or spirit; and with some nations the virtues and the vices are also endowed with personality. As the reasoning powers of men expand, their gods diminish in number and rule over larger areas, till finally it is perceived that there is unity in nature, that everything which exists is a part of one harmonious whole."—("The Martyrdom of Man," Winwood Reade, 13th edition, 1890, p. 172.)

"The Egyptian worships the cow or the crocodile, the Indian the rattlesnake, the African the Congo snake, &c. A stone, a tree, a river, an alligator, a parcel of rags, a snake, form the idols of the Negroes of Guinea. Such a worship does not express the idea of an almighty being, governing the world and ruling nature and man, but merely a blind fear of natural forces, which frighten uncivilised man, or appear supernatural, as he is not able to trace the natural connection of things."—("Force and Matter," Dr. Louis Büchner, 1864, p. 185.)

[1] "It is a somewhat striking development of commercial Christianity that there is an active manufacture of these" (idols) "in our own city of Birmingham and elsewhere, to be sent out to India, it may be, in the same ship with the missionaries."—("Chambers's Encyclopædia," 1890, article "Idolatry.")

charged with Ether and each molecule was vibrating—that the whole mass was white or red hot;[1] in fact, that there was a time when this earth was a star—a sun, or part of a larger sun.

The existence over vast areas of certain crystalline igneous rocks, called *Plutonic*, and formed probably under great heat, certainly favours this view. While the incandescent molecules cooled (i.e. lost Ether), some assumed the solid form, some the liquid form, and others the gaseous form. If this be so, the aggregation of certain classes of atomic matter in certain districts shows the remarkable affinity certain atoms and molecules had for their own species when they were free, at a certain temperature, to attract themselves together. It is magnetism at a certain temperature.

On the other hand, the existence of igneous rocks (that is, rocks that have crystallized and consolidated from a state of fusion), which have been pressed up *through* the oldest stratified rocks (that is, through rocks deposited by means of water), is direct evidence that such igneous rocks must have been in a state of fusion *after* the formation of the stratified rocks traversed by them. Now, it is quite possible that igneous rocks may result from the actual alteration and melting of stratified rocks. We know how, in contact with igneous masses, coal becomes coke, limestone becomes crystalline marble, sandstone becomes partly melted to a glassy state. If matters go as far as actual fusion, will not igneous rocks inevitably result? As it is, in many cases, fossils have been obliterated by the profound structural changes that have been set up in the strati-

[1] See "What is Heat?" for explaining these reactions.

fied rocks; and these changes are more evident as we approach the invading igneous mass. If a change from stratified rocks into igneous seems possible, is it a wonder that some geologists, of whom Hutton is a striking example, have urged that our planet shows no signs of a beginning, and that the processes that mould its surface may go on to all eternity?[1]

However this may be, the history of this world is best described as a fairy tale. Once upon a time—a time so remote that to our minds it seems eternity—the world consisted of land, water, and the gases above the land and water. All consisted of molecules built up of atoms, probably the same number of species of atoms, and probably the same atoms (minus atoms which have arrived at the earth's surface from time to time) as exist to-day. The atoms which build up organisms had not yet been able to get a footing as organisms, except, perhaps, the very lowest organisms, those amœba-like objects which have existed through all time and exist now. The waters, and the air above the waters, were ceaselessly, and are still, warring upon the solid earth, tearing it to minute pieces and depositing the very finely divided matter in the ocean; there, under great pressure, this was and is being solidified to make rocks. As the old land thus became worn down by a process tending to equilibrium, new lands appeared, they rose out of the waters. By lateral pressure the layers of rocks (*which were always deposited in the oceans and other waters horizontally, or nearly so*) become contorted in every conceivable form, and are often forced up into mountains. Water from

[1] See "Text-book of Geology," Sir Archibald Geikie, F.R.S., 3rd edition, 1893. Book iv., part viii.

the air—rain, extremes of cold and heat, the expansion of ice, have kept the mountains continuously in a state of change, a state of decay, disintegration. Thus the rivers carried the disintegrated solid material into the seas, to be deposited ultimately as fine particles on their floors. Vast rivers of ice, always in motion, carried masses of solid matter with them to the commencement of the rivers of water. The waters of the seas and rivers, of lakes and streams, and the water lying in and on the solid earth, were and are constantly evaporating to form the gaseous condition of the water molecule.[1] These molecules again contracting, aggregate themselves together to form the rain to again destroy mountains and to carry the solid into the streams, the streams into rivers, the rivers to seas or oceans. All an incessant state of change —all in perpetual, but often very slow, motion. The solid matter, molecule adhering or cohering to molecule, resists the upheaving pressure from beneath until the strain is overbearing, huge cracks are formed in the layers of the earth, faults causing differences of level of the layers, accompanied by tremors on the earth's surface—anon the release from strain is sometimes so violent as to cause the phenomena of earthquakes. Great valleys are cut out by watercourses. Great depressions in the land form the beds of lakes, and presently the confining solid matter gives way, the water rushes from the lake, and a plain between the mountains is formed, and then ultimately man arises and inhabits the fruitful soil. Pressed up by lateral pressure, we find the layers of earth rising

[1] This process is experimentally shown in "What is Heat?" p. 287.

upwards to form huge mountains, or pressed down to form deep valleys. Now the water obtains subterranean passages in the solid masses of the earth. The water molecules meet with certain molecules, and at a certain temperature they combine, or at any rate produce a compound mass of liquid rock containing water throughout.[1] This mass forces its way into any cracks which may be provided for it by movements of the earth's crust, and often emerges as lava at the surface. Then we may say a volcano is born.[2]

[1] See "The Natural History of Lavas as illustrated by the materials ejected from Krakatoa," Prof. J. W. Judd, F.R.S., Geol. Mag. 1888, p. 10.

[2] The phenomena resulting from contact of molecules may be illustrated by putting a piece of the metal potassium on water; it immediately decomposes the water, and combustion—flame is the result. Or mix some lump-sugar, ground to powder, with potassium chlorate. Dip a glass rod into sulphuric acid, and then touch the powder with the wet rod; it immediately bursts into flame—almost an explosion. There is a tendency by some to believe that volcanoes are vents for the molten boiling mass of matter beneath the crust of the earth. The evidence that volcanoes are the results of local reaction arising from the contact of water with certain molecular matter, is this: Volcanoes generally exist in the neighbourhood of seas and lakes. When active, there is often a local loss of water, as the failure of wells and springs. Volcanoes become extinct, showing that the materials for providing chemical reaction have been exhausted. But above all, the enormous amount of water in the vaporous condition—steam, ejected by the active volcanoes. It is estimated that 999 parts out of 1000 parts of the white cloud which hangs over an active volcano consist of steam. "It has often been noticed at Vesuvius that each great concussion is accompanied by a huge ball-like cloud of steam which rushes up from the crater. Doubtless it is the sudden escape of that steam which causes the explosion." — ("Text-Book of Geology," Sir Archibald Geikie, F.R.S., 3rd edition, 1893, p. 215.)

Volcanoes belong to almost all geological formations.

Masses of molecular matter are cast into the air, they fall by gravitation, they are piled up, and a volcanic mountain is created. Yet again, when the water is cut off, or the material for combination is exhausted, we have then an extinct volcano.

All, all is a state of slow change. New mountains formed, new valleys formed, new continents, new rivers, new seas, new oceans formed—old continents destroyed, old seas destroyed, yes, the rivers and the lakes depart, and the world would not know the history of life but for one remarkable fact: in many of these changes the remains of life are permanently, indelibly recorded, in these old layers of earth, aye, old as eternity (to our minds) are these remains. These fossils are the letters, the words, the sentences, and chapters of the past history of the life on our earth—our stone Bible.[1]

And this fairy-like tale continues. All the phenomena continue, and tend to the view that they will continue for a time that to our minds is expressed in the words—for ever.

Incessant change, incessant warfare of molecular motion, of molecular generation and regeneration, such is the history of the present and the past of this world.

[1] "The Geological Record is at the best but an imperfect chronicle of the geological history of the earth. It abounds in gaps, some of which have been caused by the destruction of strata owing to metamorphism, denudation, or otherwise, some by original non-deposition, as above explained. Nevertheless, it is from this record that the progress of the earth is chiefly traced. It contains the registers of the births and deaths of tribes of plants and animals, which have from time to time lived on the earth. Probably only a small proportion of the total number of species, which have appeared in past time, have been thus chronicled, yet, by collecting the broken fragments of the record, an outline at least of the history of life upon the earth can be deciphered."—(*Idem*, p. 677.)

Although we cannot give moments of date when the alterations took place (neither can we do this generally in very ancient human history), sufficient facts are now made known to us in order to grasp the absolutely stupendous time required for the deposits containing organic remains now found to exist in the crust of the earth.[1]

[1] "The argument from geological evidence indicates an interval of probably not much less than 100 million years since the earliest forms of life appeared upon the earth, and the oldest stratified rocks began to be laid down."—("Text-Book of Geology," Sir Archibald Geikie, F.R.S., 3rd edition, 1893, p. 58.)

It is questionable if such deductions, however, are not vain, and why? Because the past is but a repetition of the present. At the present moment the forces of Nature are destroying the records of the past. A few hours' direct observation teaches much more than reading volumes of books. Perhaps there is no locality more favourable for a Londoner to make these observations than the Isle of Wight, and a delightful walk round the coast reveals in a wonderful way the destroying influences now going on. The diagram below shows the structure of the island. It is from Mantell's "Geological Excursions round the Isle of Wight."

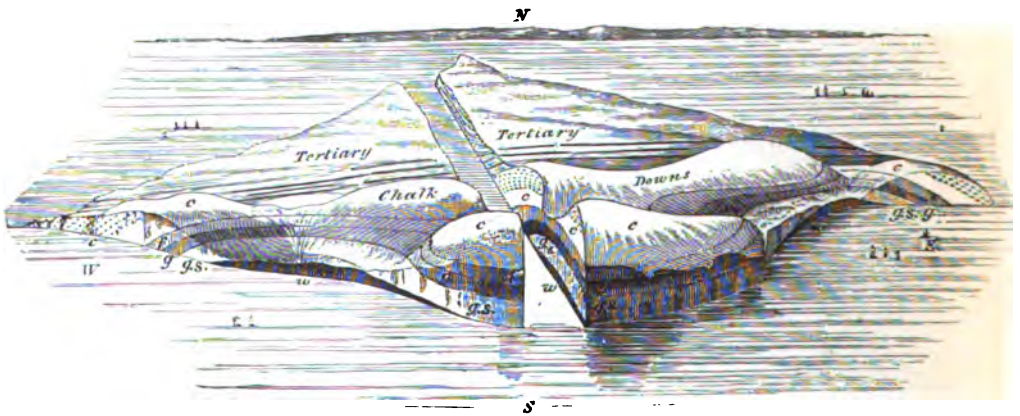

Fig. 19.—Diagram illustrative of the geological structure of the Isle of Wight. *c*, Upper and Lower chalk; *f*, Upper Greensand; *g*, Gault; *g*, *s*, Lower Greensand; *w*, Wealden.

At the south-east, near Dunnose Point, we find layers of large

Amidst all these changes, as the earth lost what is called temperature, it became in a condition fit for the existence of organic life, life sprang, as we call it, spontaneously into existence. But what is the origin of this so-called vegetable and animal Life? A certain species of atomic matter able to attract and combine with other molecular matter, giving out the potentialities of matter, and we have the form of the first organism in this stupendous creation of the past, of the present, and of the future. The molecules come together by their mutual attractions, and we have what is called Protoplasm—the basis of organic life. Then the simple organic cell with its nucleus and its

oyster-like shells cropping out of the sides of the cliffs, and the fossils lying on the shore—fossil wood, etc.; and as we near Shanklin we find masses of hardened clay casts of fossils. At Whitecliff Bay, the east of the island, the strata become vertical—layers of rock composed almost wholly of fossils are seen rising from the shore up to the top of the cliff. Walking at the base of the cliff towards Bembridge, we walk upon a nearly horizontal layer of a species of small oyster. The formation of the island shows that it has been the result of a great upheaval or series of upheavals, as if some giant had taken an iron bar, placed it beneath the island and forced up the mass, bending up and breaking the chalk formation, making the charming downs which pass through the centre of the island and cap the south of it. So powerful has been the pressure that the flints are broken into minute fragments. Now the point to be observed is this: here are masses of formations, layer after layer, being destroyed by the destructive influences at work, and cast into the sea. The geological history is being obliterated for ever. Although this defect in the strata of the past makes all calculation of time impossible, yet the gaps are often filled up elsewhere. All we can do is to assign a life period to the fossil remains, a time for upheaval and the various alterations of the earth's crust, and then we may estimate a minimum record of the world's history, and a minimum only. To our minds the world's history has a record of eternity.

nucleolus appears, and has continued to appear. It may be considered simply as a mass of nervous matter, exciteable, that is sensitive, to light, to heat (i.e. Ether), and amenable to the other forces in Nature. Simply a mass of molecules, every one of which is alive.

Geologists divide the crust of the earth into five great groups, which we may, in order to avoid technical detail, classify thus :—

1. Ante-primary Rocks.
2. Primary Rocks.
3. Secondary Rocks.
4. Tertiary Rocks.
5. Post-tertiary Rocks.

The strata of the primary and subsequent rocks are subdivided into a number of local divisions. All these rocks were originally laid down by means of water in a more or less horizontal manner, frequently in oceans or seas. We put some sand in a bottle of water, shake it up, and we find the coarse particles fall the first, the finer after, and the finest last. And so are strata formed by the finer particles floating to the depths of the ocean and the coarser particles deposited near the sea-shore. But the deposits as a whole are placed horizontally; it is as if Nature tried to deposit by the spirit level. Simple as the experiment with the bottle is, it illustrates the basis of all the phenomena in Nature as regards the original deposition of a very large mass of the material of which the earth's surface is formed.

Now below all these stratified formations there are huge formations, called the ante-primary rocks. These formations include the great bulk of "igneous" and "metamorphic" rocks. Many "metamorphic" rocks appear to be in a transition state between the igneous

rocks and the sedimentary rocks. These latter rocks appear to have been partly changed into igneous rocks *after* they had been deposited,[1] and this may have been done by great heat and pressure.

Now it is possible, with the evidence before us, to believe that the condition of igneous rocks may merely arise from certain matter, which has great affinity molecule for molecule, and in the combination great heat was evolved, and under the influence of this heat crystallization took place. It matters not whether the earth were once, as a whole, in an incandescent state, and subsequently slowly, very slowly, cooled ; all we have to understand is, that, at the base of all rocks, there are these ancient igneous rocks, formed probably under great pressure and at a very high temperature.

Of the thickness of these igneous rocks we know absolutely nothing. We cannot get to the bottom of

[1] "In this section" (the Metamorphic rocks) "is comprised a series of rocks which present a remarkable system of divisional planes that are not original but have been superinduced upon them. At the one end stand rocks which are unmistakably of sedimentary origin, for their original bedding can often be distinctly seen, and they also contain organic remains similar to those found in ordinary unaltered sedimentary strata. At the other end come coarsely crystalline masses, which in many respects resemble granite, and the original character of which is not obvious."—("Text-Book of Geology," Sir Archibald Geikie, F.R.S., 3rd edition, 1893, p. 175.)

This evidence tends to the view that igneous rocks may be changed sedimentary rocks—changed by heat and great pressure. If this alteration be simply caused by chemical reaction, it is not necessary to suppose the earth was originally in an incandescent white or red-hot condition. If this view is true, then the age of the world during which life existed must be very vastly increased over that which has been estimated.

them. Most probably the earth is a hollow spheroidal mass.[1] Now inasmuch as these igneous rocks rise to the surface of the earth, it is most likely that often the whole thickness of the crust of the earth may be igneous rocks; if so, how enormous must be the thickness!

If the earth were once wholly incandescent, then all sedimentary rocks must have been formed from igneous rocks—rocks which must have been reduced to exceedingly fine particles to form the various clays, &c., which we find in Nature.

We cannot therefore tell the origin of the earth, or even of the igneous rocks. It is enough for man to know that *they are.*

Thus, then, lying over these ancient "igneous" and "metamorphic" rocks, which often consist of granite, are the various formations to which we have just drawn attention. It is estimated by geologists that these ante-primary rocks which have been partly altered into igneous rocks are sometimes 30,000 feet thick. The primary rocks which are deposited on the top of the ante-primary rocks are found 106,000 feet thick, making a total of about 136,000 feet, or nearly twenty-six miles. The secondary rocks which are deposited on the top of the primary rocks may be met with 25,000 feet, or nearly five miles thick. The tertiary rocks which are laid upon the secondary rocks are sometimes 27,000 feet, or over five miles thick. While the post-tertiary layers, the last deposits of all, are found 500 feet thick.[2] These are very approximate measurements. There are no hard and fast lines—the

[1] For the reasons see "What is Heat?" p. 104.

[2] "The Story of our Planet." T. G. Bonney, D.Sc., LL.D., F.R.S., 1897, p. 365.

thickness varies everywhere. Nature always abhors the rigid.

Now comes the important fact. In the first layers of the primary formations, we have records of the creation of low or comparatively humble organisms—the traces of organic life are rare. Later on, we have a greater abundance of forms, the humbler types, however, still preponderating—all (except the very lowest) were built up of cells and the product or secretion of cells—each cell with its nucleus and its nucleolus,[1] each cell a living organism. In the next era, that is during the time the secondary strata were deposited, we find pine forests and reptiles, and the lowest forms of mammals—again all were built up of cells and the secretions of cells—all of which had their nucleus and their nucleolus, all cells living individuals. All cells were built up of molecules, all molecules built up of atoms. The next formation, the tertiary formation, denotes an era in which the modern types of forest predominated—trees having a true bark and growing from the outside, and a surprising development of the creatures that suckle their young—mammals. And lastly appears the post-tertiary era, during which many of the present forms of vegetable and animal life, including Man, were created.[2] Each so-called creation was the Evolution of the more complex from the less complex until the most complex of all appeared—civilized man.[3]

[1] The whole of the remainder of the Book assumes Prof. Schäfer's fundamental deductions to be true.—See p. 80.

[2] i.e. sprang into existence. The word "creation" is always used by the Author in this sense.

[3] "The law of progress or of perfecting establishes the exceedingly important fact, on the ground of palæontological experience, that in

But all animals, all vegetables, even Man himself, were and are built up of cells and the secretions of cells—

successive periods of this earth's history, a continual increase in the perfection of organic formations has taken place. Since that inconceivably remote period in which life on our planet began with the spontaneous generation of Monera, organisms of all groups, both collectively as well as individually, have continually become more perfectly and highly developed. The steadily increasing *variety* of living forms has always been accompanied by *progress* in organization. The lower the strata of the earth in which the remains of extinct animals and plants lie buried, that is, the older the strata are, the more simple and imperfect are the forms which they contain. This applies to organisms collectively, as well as to every single large or small group of them, setting aside, of course, those exceptions which are due to the process of degeneration, which we shall discuss hereafter.

"As a confirmation of this law I shall mention only the most important of all animal groups, the tribe of vertebrate animals. The oldest fossil remains of vertebrate animals known to us belong to the lowest class, that of Fishes. Upon these there followed later more perfect Amphibious animals, then Reptiles, and lastly, at a much later period, the most highly organized classes of vertebrate animals, Birds and Mammals. Of the latter only the lowest and most imperfect forms, without placenta, appeared at first, such as the pouched animals (Marsupials), and afterwards, at a much later period, the more perfect mammals, with placenta. Of these, also, at first only the lower kinds appeared, the higher forms later; and not until the late tertiary period did man gradually develop out of these last.

"If we follow the historical development of the vegetable kingdom we shall find the same law operative there. Of plants there existed at first only the lowest and most imperfect classes, the Algæ or tangles. Later there followed the group of Ferns or Filicinæ (ferns, pole-reeds, scale-plants, etc.). But as yet there existed no flowering plants, or Phanerogama. These originated later with the Gymnosperms (firs and cycads), whose whole structure stands far below that of the other flowering plants (Angiosperms), and forms the transition from the group of fern-like plants to the Angiosperms. These latter developed at a still later date, and among them there were at first only flowering plants without corolla (Monocotyledons and Monochlamyds);

each cell having its nucleus and nucleolus—every cell a living creature, all built up of atoms.[1]

The various or distinct types of animals and vegetables are called by the classifiers of nature, species.[2] There is no hard and fast line in the classifica-

only later were there flowering plants with a corolla (Dichlamyds). Finally, again, among these the lower polypetalous plants preceded the higher gamopetalous plants. The whole series thus constitutes an irrefutable proof of the great law of progressive development. . . . We can trace the same thing in the history of the human race. Here, too, it is natural and necessary that the progressive division of labour constantly furthers mankind, and urges every individual branch of human activity into new discoveries and improvements. This progress itself universally depends on differentiation, and is consequently, like it, a direct result of natural selection in the struggle for life.

"If man wishes to understand his position in nature, and to comprehend as natural facts his relations to the phenomena of the world cognizable by him, it is absolutely necessary that he should compare human with extra-human phenomena, and, above all, with animal phenomena."—("The History of Creation," Professor Ernst Haeckel, 1892, vol. i. pp. 316-319.)

[1] A mind educated in pure reason cannot help arriving at the issue we have presented when reasoning from atomic and molecular potentialities, thus: "These are the sort of difficulties which have led the scientific world, I may say universally, to abandon the idea of separate special creations, and to substitute for it that which has been proved to be true of the whole inorganic world of stars, suns, planets, and all forms of matter; the idea of an original creation (whatever creation may mean and behind which we cannot go) of ultimate atoms or germs, so perfect that they carried within them all the phenomena of the universe by a necessary process of evolution."—("Modern Science and Modern Thought," S. Laing, 1896, p. 96.)

[2] "There are probably something like a quarter of a million different kinds of living and extinct animals and plants, and a human life could not suffice for the examination of one fiftieth part of all of these."—("On the Study of Biology," see American Addresses, Thos. H. Huxley, 1877, p. 153.)

tion. It is difficult to know in many cases where one species begins or one ends. Nature abhors the rigid.[1] But many of the most marked types in this long geological time—a time which is infinite to our minds—have died out, never to return. When, however, a type is formed, it tends to specialize itself. Hence the tendency that like breeds like. This tendency to propagate a type is called *inheritance*, but it is found there are always slight variations, and the adaptation to external conditions causes a slow growth of alterations in form. These slow alterations are called *adaptations*. All types have been produced by a process which is now fairly understood and known as the law of *the struggle for existence* and the survival of the fittest. This is acknowledged by all naturalists, and this

[1] "It must be mentioned that very recently the important theoretical question as to the nature and idea of 'kind' or 'species,' which is the point on which really hang all the disputes about the Theory of Descent, has been definitely settled. For more than a century this question was discussed from the most varied points of view, without resulting in a satisfactory settlement. During that time thousands of zoologists and botanists have occupied themselves in systematically distinguishing and describing species, without, however, any clear idea of the meaning of 'species.' Many hundred thousand vegetable and animal forms were set up and marked as good species, though even those who declared them such were unable to justify the proceeding, or to give logical reasons for thus distinguishing them. Endless disputes arose among the 'pure systematizers,' on the empty question, whether the form called a species was 'a good or bad species, a species or a variety, a sub-species or a group,' without the question being even put as to what these terms really contained and comprised. If they had earnestly endeavoured to gain a clear conception of the terms, they would long ago have perceived that they have no absolute meaning, but are merely stages in the classification, or systematic categories, and of relative importance only."—("The Evolution of Man," Prof. Ernst Haeckel, 1883, vol. i. p. 115.)

struggle continues.[1] When a type, or as it is called a species, has once got its footing in existence or, as it is called, is "created," it tends to part from and leave behind the type or species from which it sprang, hence the connecting links are rare. And this is markedly

[1] "No motives appear to be able to stay the progress of such movements, humanise them how we may. We often, in a self-accusing spirit attribute the gradual disappearance of aboriginal peoples to the effects of our vices upon them; but the truth is that what may be called the virtues of our civilisation are scarcely less fatal than its vices. Those features of Western civilisation which are most distinctive and characteristic, and of which we are most proud, are almost as disastrous in their effects as the evils of which complaint is so often made. There is a certain grim pathos in the remark of the author of a paper on the New Zealand natives, which appeared in the *Journal of the Anthropological Institute* a few years ago" (1887), "who, amongst the causes to which the decay of the natives might be attributed, mentioned, indiscriminately, drink, disease, European clothing, peace and wealth. In whatever part of the world we look, amongst civilised or uncivilised peoples, history seems to have taken the same course. Of the Australian natives 'only a few remnants of the powerful tribes linger on. . . . All the Tasmanians are gone, and the Maoris will soon be following. The Pacific Islanders are departing childless. The Australian natives as surely are descending to the grave. Old races everywhere give place to the new.' There are probably, says Mr. F. Galton, 'hardly any spots on the earth that have not, within the last few thousand years, been tenanted by very different races.' Wherever a superior race comes into close contact and competition with an inferior race, the result seems to be much the same, whether it is arrived at by the rude method of wars of conquest, or by the silent process which we see at work in Australia, New Zealand, and the North American Continent, or by the subtle, though no less efficient method with which science makes us acquainted, and which is in operation in many parts of our civilisation, where extinction works slowly and unnoticed through the earlier marriages, the greater vitality, and the better chance of livelihood of the members of the superior race."—("Social Evolution," Benjamin Kidd, 1895, p. 51.)

shown in the creation of Man—the last, the most complex and the highest organism. Man has sprung from the man-like animals—the apes. He is structurally formed in a like mould—bone for bone, muscle for muscle, nerve for nerve, each and all are homologous in man and the higher apes.[1] And yet there is a gap.[2]

[1] "An uninterrupted chain of transitions and similitudes connects the whole animal world, from the lowest to the highest types. Even man, who, in his presumption, deems himself so far superior to the animal world, forms no exception to this law. The Ethiopian race connects him by a number of the most striking similitudes with the animal world. The long arm, the shape of the foot, the thin calves, the long and narrow hands, the flattened nose, the projecting jaws, the depressed receding forehead, the elongated head, the short neck, the narrow pelvis, the pendulous belly, the beardless chin, the colour of the skin, the disagreeable odour, the sharp and piercing voice, are all the characteristic marks which approach *the negro to the ape*. That his mind corresponds to his *physique* has been established by the best observers."—("Force and Matter," Dr. Louis Büchner, 1864, p. 75.)

"In proof of the assertion that the hairy covering of Man is directly inherited from the Anthropoid apes, we find, according to Darwin, a curious evidence in the direction, otherwise inexplicable, in which the rudimentary hairs lie on our arms. Both on the upper and on the lower arm the hairs are directed towards the elbow, where they meet at an obtuse angle. Except in Man, this striking arrangement occurs only in the Anthropoid Apes, the Gorilla, Chimpanzee, Orang, and several species of Gibbons."—("The Evolution of Man," Prof. Ernst Haeckel, 1883, vol. ii. p. 208.)

[2] "It is evident, therefore, that these two branches of the Primates, man and ape, follow diverging lines of development, and can never be transformed into one another, and that the 'missing links' to connect the human species with the common law of evolution of the animal kingdom, are to be sought in other directions than that of direct descent from any existing form of ape or monkey. . . . Not only have we found no fossil remains which stand to modern man in something of the same relation as the Hipparion does to the horse, but nothing has yet been discovered which seems to carry us so far

"There is no existing link between Man and the Gorilla, but do not forget that there is a no less sharp line of demarcation, a no less complete absence of any transitional form between the Gorilla and the Orang, or the Orang and the Gibbon." [1]

How are we to understand these gaps? [2] We must bear in mind that the evidence tends to the fact

in that direction as is done by a comparison with some of the existing savage races. The number of skulls and skeletons dating back to early Quaternary times, distant from us certainly not less than 50,000 years, and probably much more, is now so great as to enable us to speak confidently as to their character, and even to classify their different types."—("Problems of the Future," S. Laing, 1894, pp. 156, 158.)

Since this was written a further step towards discovering the 'missing link' has been found in Java (1895). Dr. D. J. Cunningham after describing the remains, which are believed to belong to the Pleistocene period, and deciding that they were human, and the lowest human remains which have yet been described, concludes thus: "Most certainly they are not derived from a transition form between any of the existing anthropoid apes and man; such a form does not and cannot exist, seeing that the divarication of the ape and man has taken place low down in the genealogical tree, and each has followed, for good or bad, his own path. The so-called Pithecanthropus is the direct human line, although it occupies a place on this considerably lower than any human form at present known."—("Nature," February 28th, 1895.)

[1] "Evidence as to Man's Place in Nature," Prof. Huxley, 1864, p. 104.

[2] "And yet with this close identity of anatomical conditions there is, as Huxley emphatically asserts, a wide gap between man and the highest ape, which has never been bridged over, and which precludes the idea of direct lineal descent from one to the other, though it implies close relationship. The differences are partly physical and partly intellectual. Of the former, it may be said that they may be all summed up in the fact that man is specialized for erect posture."—("Problems of the Future," S. Laing, 1894, p. 149.)

that it is the innate powers of the cell, the commander-in-chief of the organic entities—the cells, which keep the army of which the organism consists together to form the whole being we call an organism—a man or gorilla. This cell has its nucleus and its nucleolus. It is a group of molecules, formed of atoms commanded by a molecule in which there is the fundamental atom. This fundamental species of atom collects the groups of molecules which are called the ape. Let the ape be the parent stock. It is through this parent stock that the fundamental atom, which is in time to form an organism of the highest order—civilized man, gets its footing. It is as a parasite in the ovary of the lower organism—the ape, it immediately asserts its specific inherent powers, and thus we have the creation of the higher order through a lower order, and the human being is, as it is called, *created*. A creature at first so low in organization that he was doubtless hairy, like the ape, just capable of breaking stones for weapons, living in caves, unkempt, degraded. In process of time, perhaps millions of years, this species of organism, by very slow and minute alteration in structure, by natural selection, by the survival of the fittest, has become the present highly-cultured, civilized human being. A being chiefly remarkable for his enormous number of thinking cells. How wonderful and complex is Nature!

And so in the order of things has progressive creation taken place, always the simple merging into the complex, the complex into the more complex. Always the departure of the new species from the old species from which it has obtained its initial footing. The characteristics of species may be compared to the movement of

pendulums, oscillating, some oscillating above and some below a mean. It is when a pendulum accidentally, or to our minds accidentally, oscillates beyond a mean, touching a stationary pendulum and thus setting it in swing, that we get the development of a new species. In Man the pendulum is swinging into a region of high mental culture. Is he to form the host for the development of a still higher organism? We cannot know, but all tends to the result, that he will alter to such a high mental condition that the present mental power will, in a short time, be regarded as mere barbarism.[1]

[1] "We are proud of having so immensely outstripped our lower animal ancestors, and derive from it the consoling assurance that in future also, mankind, as a whole, will follow the glorious career of progressive development, and attain a still higher degree of mental perfection. When viewed in this light the Theory of Descent, as applied to man, opens up the most encouraging prospects for the future, and frees us from all those anxious fears which have been the scarecrows of our opponents.

"We can even now foresee with certainty that the complete victory of our Theory of Development will bear immensely rich fruits—fruits which have no equal in the whole history of the civilization of mankind. Its first and most direct result—the complete reform of Biology—will necessarily be followed by a still more important and fruitful reform of Anthropology. From this new theory of man there will be developed a new philosophy, not like most of the airy systems of metaphysical speculation hitherto prevalent, but one founded upon the solid ground of Comparative Zoology. Just as this new monistic philosophy first opens up to us a true understanding of the real universe, so its application to practical human life must open up a new road towards moral perfection. By its aid we shall at last begin to raise ourselves out of the state of social barbarism in which, notwithstanding the much-vaunted civilization of our century, we are still plunged. For, unfortunately, it is only too true, as Alfred Wallace remarks with regard to this, at the end of his book of travels: 'Compared with our wondrous progress in physical science and its practical applications, our system of government, of administering

Man is destined to ascend, and this ascending order of structure and mind is forced upon him.

justice, of national education, and our whole social and moral organization remain in a state of barbarism.' "

'This social and moral barbarism we shall never overcome by the artificial and perverse training, the one-sided and defective teaching, the inner untruth and the external tinsel of our present state of civilization. It is above all things necessary to make a complete and honest return to Nature and to natural relations. This return, however, will only become possible when man sees and understands his true 'place in Nature.' He will then, as Fritz Ratzel has excellently remarked, 'no longer consider himself an exception to natural laws, but begin to seek for what is lawful in his own actions and thoughts, and endeavour to lead a life according to natural laws.' He will come to arrange his life with his fellow-creatures—that is, the family and the state—not according to the laws of distant centuries, but according to the rational principles deduced from knowledge of nature. Politics, morals, and the principles of justice, which are still drawn from all possible sources, will have to be formed in accordance with natural laws only."—("The History of Creation," Prof. Ernst Haeckel, 1892, vol. ii. pp. 495-497.)

II.

FURTHER DETAILS OF THE READING OF THE GREAT STONE BIBLE.

It is desirable to enter a little more into the details of the past history of the Earth, as read in this wonderful Stone Bible. The record is very imperfect, pages, chapters, and whole books are wanting—the gaps are numerous and often of gigantic dimensions. Perhaps nothing can more clearly show the cause of the existence of these gaps than the erosion or wearing away of the cliffs at the sea-shore now going on. Here strata after strata of the earth's surface are gradually being ground to fine particles and then thrown into the sea, and carried out into its deep waters; there deposited to form new layers or strata which will some day appear above the surface of the oceans. We have every reason to believe that the like process has gone on, to our minds, for an infinite time. These deposits form the record of the earth's history, sufficient remains to tell an all-absorbing tale.

In reading the history of fossil remains, as the remains of life are called, found in these layers, it must always be kept in mind how little is left of the creation

which has existed from time to time. All of the soft parts of the organism become obliterated.[1] It is only the hard, bony, or shell-like structures of animals of which remains exist, although casts of soft-bodied animals and plants are left. Of the remains therefore, of which we have a record, the number is a mere sample of the whole. In these fossils there is the clearest evidence to be seen that there existed soft parts, as the place is always clearly indicated, where the soft parts attached themselves to the hard parts, as tendons to the bone or muscle to the shell. Sometimes the original object is replaced by other matter, but so as to preserve the entire form and often the minute detail of the original organism. Sometimes it is entirely destroyed, and only a cast, often of hard clay, is left, but this cast is very perfect. We must keep in view that each stratum or layer has its special types of animals or plants, but there are no

[1] If decomposition and regeneration were not facts, the world would soon be choked up with organic matter. "How does the world escape being choked up by the accumulation of dead organic matter throughout innumerable ages?"—("A Modern Zoroastrian," S. Laing, 1895, p. 87.) "But then the question was asked, 'How are your microscopic organisms disposed of? What are the ferments of your ferments?' For even microscopic bacteria and vibrios would in time choke up the world by their residue if not got rid of. Pasteur answered that the ferments are destroyed by a new series of organisms—aerobes—living in the air, and these by other aerobes in succession until the ultimate products are oxidised. 'Thus, in the destruction of what has lived, all is reduced to the simultaneous action of the three great natural phenomena—fermentation, putrefaction, and slow combustion. A living being, animal or vegetable, or the *débris* of either, having just died, is exposed to the air. The life that has abandoned it is succeeded by life under other forms."—("A Modern Zoroastrian," S. Laing, 1895, p. 87.)

hard and fast lines in their distribution, since they often pass from one stratum into another.

The First Book of the Stone Bible.

In the classification of the various strata the lowest main division—the first great book—is called by geologists, *Primary Rocks.* Underlying these are still older layers or strata called by geologists, the *pre-Cambrian Rocks.* These strata are often highly metamorphosed, and may even have been converted into igneous rocks; this may have been done by the melting of the rocks, which were usually laid down by the action of water.

"In these primeval deposits there are records of denudation and deposition, of alternate sedimentation and terrestrial movements, of stupendous and prolonged volcanic activity, and of distinct though scanty proofs that plant and animal life had already appeared upon the face of the globe."[1] Here we find evidences of great volcanic action. "The vast scale of these volcanic eruptions may be inferred from the fact that in the Lake Superior region the accumulated materials discharged at the surface attained a thickness which has been estimated at more than six and a half miles."[2] . . . "Hills and valleys, lines of cliff and crag, rocky slopes and undulating hollows have been revealed by the slow denudation of the pre-Cambrian strata."[3] In fact the physical conditions of the earth at this vastly remote period were similar to those of the present day.

[1] ("Text-book of Geology," Sir Archibald Geikie, F.R.S., 3rd edition, 1893, p. 681.)

[2] *Idem*, p. 692.

[3] *Idem*, p. 693.

In these deposits there are layers of limestone of such an extraordinary structure, as to make many eminent geologists believe that they were formed by a simple organism, consisting of what is termed protoplasm, probably masses of simple living molecules, each having an independent motion, but these molecules in living protoplasm are so minute as to be incapable of being seen by the very highest magnifying power. The mass of these objects secreted the carbonate of lime from the water and thus formed its living-place, protruding the living matter through minute holes in the shell and thus obtaining its food. Such is one explanation of the ancient mass called the *Eozoon Canadense*. It is estimated that one band of this formation of limestone in the Ottawa district reaches a thickness of nearly thirty feet. This is believed by many able geologists to be the first evidence of life on the surface of the earth. Whether this is so or not, "it may be admitted that no structure precisely similar to that of some of the specimens of *Eozoon* has yet been discovered in the mineral kingdom." [1]

It matters little if this be regarded as indications of the first life, for there is sufficient evidence that life existed in the pre-Cambrian strata.[2] This life was probably of the lowest type. "The mere thickness and variety of the pre-Cambrian formations, together with their unconformabilities and other structural features, suffice to prove that they represent an enormous chronological interval. In North America, where, so far as at present known, they are most extensively

[1] *Idem*, p. 695. [2] *Idem*, p. 694.

developed, they are estimated to attain a thickness of more than 65,000 feet, or upwards of twelve miles." [1]

The pre-Cambrian rocks are found in Great Britain, Norway, Sweden, North America, India, China and Australia.

Lying upon or over the pre-Cambrian rocks, was subsequently deposited a series of strata called by geologists the *Cambrian* rocks, and forming the first of the Primary formations. "Much interest necessarily attaches to Cambrian fossils, for excepting the few and obscure organic remains obtained from pre-Cambrian strata, they are the oldest assemblage of organisms yet known." . . . "One of the first reflections which they suggest is that they present far too varied and highly organised a suite of organisms to allow us for a moment to suppose that they indicate the first fauna of our earth's surface. Unquestionably they must have had a long series of ancestors, though of these still earlier forms such slight traces have yet been recovered." [2]

The Cambrian rocks in some places differ little from the pre-Cambrian rocks below them; but in other places there is a marked break between them. Ripple marks, formed by water as now seen on the sea-shore, and sun-cracks are found in these rocks.

Plants are scarcely at all found in these strata. No vestige of land plants has been detected. Traces of sea-weeds are believed to be found.

Sponges, star-fish, jelly-fish (of which casts are found) and crinoids, a group of echinoderms fixed to the earth by a long stalk, existed when these rocks were

[1] *Idem*, p. 697. [2] *Idem*, p. 720.

deposited. Worms are traced by their frequent trails and burrows. The most abundantly preserved forms of life are crustaceans, that is, animals having their skeleton outside, like lobsters and crabs—here represented by the trilobites. Brachiopods, a humble class of shell-fish, existed in abundance. Some of the latter, with but little change, have existed from this vastly remote period to the present day.

All these animals were built up of cells. All the cells were living creatures as now. The shells of the shell-fish and trilobites were formed by the mass of cells collectively called the living fish. All past life is like the present, but not so complex. The process was the same, the birth, growth, and final death of each individual took place by the same inexorable laws as exist to-day, each organism leaving the shell and the hard substances to be the geological record of the history of the individual.

The Cambrian rocks are found in Great Britain, Norway, Sweden, Central Europe, North America, South America, India and Australia.

The next great system of strata lying over and upon the Cambrian strata, and subsequently deposited, is a series of rocks called by the geologist the *Silurian* rocks. Again there is no hard and fast line, the Silurian rocks merge into the Cambrian rocks. Seaweeds are often beautifully preserved in these rocks. Traces of land plants are found.

Foraminifera, that is, minute shells secreted by the simplest form of life—protoplasm, existed, some of which have passed through the whole of subsequent geological time to the present day. Sponges grew in these ancient seas. Corals swarmed in parts of the

ancient sea-floors, star-fish and worms lived then. Crustacea are abundantly preserved in these formations, for we may include the Trilobites under this head, now that they are known to possess antennæ. The lowest orders of shell-fish were very abundant in those days. Some of the genera exist at the present day. Fishes now appear in the upper layers of these rocks—the first evidence of vertebrated life, that is, animals which have back-bones. The records of these animals, however, are scanty. No traces of vertebrated land animals are yet found. Scorpions lived when these rocks were deposited, having a poison gland and sting in the tail the same as the modern creature has. Insects also lived in these times.

The Silurian rocks are found in Britain 19,500 feet thick—more than three and a half miles, also in Russia, Norway and Sweden, France, Central and Southern Europe, North America, Asia and Australia.

Already, then, we see that Nature's book shows a distinct advance from the simple to the more complex organisms, while the proportions in which the several life-groups occurred in Cambrian times have markedly changed by the time that we reach the top of the Silurian.

The next system of strata, or those which were deposited after and upon the foregoing groups of rocks, is called by geologists, the *Devonian* rocks. These rocks merge into the Silurian rocks—there is no distinct boundary. On the top of the latter and representing the Devonian rocks are in places the red rocks, known as the Old Red Sandstone, 20,000 feet —nearly four miles—thick. These rocks in the British Isles are destitute of marine life.

The species which existed in Silurian times are largely replaced by other species.

Plant life, not bearing flowers, already existed when these layers were deposited. Ferns and huge tree-like club-mosses then lived, as also cone-bearing trees, like the firs.

The remains of animal life in these formations are both freshwater and marine. Corals are abundant, but the prevalent species are different from those of the Silurian system. The crinoids sometimes formed entire beds of rock. The lower classes of shell-fish are still abundant. Trilobites, which were hitherto abundant, begin to be scarce. Insects and scorpions lived when these formations were being deposited. But these were times when fishes began to prevail over the large crustacea and their allies. The ganoids —fishes similar in type to our sturgeons—were the most varied in these waters. One species was most formidable, specimens having been found where the head alone, enclosed in strong plates, attained a length of three feet, and was armed with a powerful apparatus of teeth.

The Devonian rocks are found in Britain, Norway, Central Europe, Russia, North America, and Australia.

The *Carboniferous* strata are those which were deposited over and upon the Devonian rocks. The system obtains its name from the numerous seams of coal which exist in it. Again there is no sharp line between these layers and the previous division. It must not be thought that these strata consist solely of coal, this is only a small part of the formation. Coal exists in thin as well as thick layers. A seam may consist of cannel coal at one part of a mineral field, and

ordinary soft coal at a second, and may consist of an iron-stone at a third part. Coal usually rests upon a bed of fire-clay or shale, through which the roots of the trees, of which coal is partly formed, branch in all directions. Very little is known of the conditions under which coal was deposited. The evidence tends to the view that the vegetation which formed coal grew in marshes near the sea. The nearest analogy to these conditions is probably furnished by the cypress swamps or the mangrove swamps existing in Florida, Bermuda, and other places. That coal is of vegetable origin may be shown by inspecting a thin section of coal by means of the microscope. In some coal there are seen a considerable number of the spore cases which held the spores—the fruit of the vegetation, which has been compressed and hardened in time, to form what we call coal. From the "fact that a succession of coal-seams, each representing a former surface of terrestrial vegetation, can be seen in a single coal-field extending through a vertical thickness of 10,000 feet or more, it is clear that the strata of such a field must have been laid down during prolonged and extensive subsidence."[1] Most probably the vegetation grew under a moist and warm climate.

Plant life in these strata, presents special interest, inasmuch as it forms the oldest terrestrial vegetation which has been abundantly preserved. It presents a singular monotony all over the world from the Equator to the Arctic circle. Plant life consisted of the lower classes as club-mosses, ferns, &c., which under a moist

[1] "Text-Book of Geology," Sir Archibald Geikie, F.R.S., 3rd edition, 1893, p. 808.

and warm atmosphere grew to a great size. Our modern horse-tails had their allies in huge trees among the Carboniferous jungles, and the familiar club-moss of our hills, now a low creeping plant, was represented by tall stemmed trees that rose fifty feet or more into the air.

Amongst the forms of animal life that existed, when these layers of rocks were being formed, are corals and crinoids, the latter were so abundant that their separate joints formed solid masses of rock several hundred feet in thickness. The ordinary bivalves—the lamellibranchs (mollusks of which the mussel is a type) in these strata, begin to hold their own against the brachiopods (a simpler form of bivalve), the latter more freely existed in previous formations. Some of the genera that now spring into life exist to this day. Trilobites almost wholly disappear. Fishes existed in variety. True terrestrial animals seem more abundant during this period. Ancient forms of may-fly, cockroach, cricket, and large beetles are found in these formations. Insects indeed flourished when these layers were deposited, some of considerable size, the spread of the wings measuring fourteen inches or more, and one species had a wing twelve inches in length. Scorpions of gigantic size have been found. Forms of spiders appear. Large amphibious animals, capable of living on land or in water, measuring seven or eight feet long, lived then. They were of the Salamander type, with relatively weak limbs and long tails—sometimes the limbs were undeveloped, so that the body was serpent-like. On the whole the types of life were of a higher form than that which had gone before.

The Carboniferous strata are found in the British

Islands, France and Belgium, Germany, Italy, Russia, Africa, America, Asia, and Australia.

The *Permian* strata, the last formation of the Primary rocks, were subsequently deposited above and upon the Carboniferous rocks. This system merges from the older system; there is no distinct line, for instance, in India or North America. In fact, these formations were formerly regarded as part of the Carboniferous formation. The life in the Permian formations differed but little from that of the Carboniferous. A new order of vegetable life now appears in force in these strata—the Cycads, plants resembling tree ferns in general aspect, but having a higher mode of reproduction. Now there exist true reptiles having remarkable characters, especially as regards their teeth, which serve to connect them with the mammals of later times.

The Permian rocks are found in Britain, Germany, France, Russia, Asia, Africa, Australia, and North America.

Thus ends the abstract of the contents of the first book of this wonderful stone Bible. Each division may be regarded as a huge chapter, each layer as an enormous page. The history is continuous, with certain gaps, from page to page, from chapter to chapter, and now we shall find from book to book. Nature recognizes no hard and fast lines. Nature abhors the rigid.

The Second Book of the Stone Bible.

We commence the second great group of strata, our second division or book in the geological record. The rocks of the first or Primary formation merge into

the rocks of the Secondary formation. Many of the leading types of life which existed in the Primary rocks now disappear. The trilobites have become extinct. The rocks belonging to the Secondary era have not generally been subject to the same marked distortion as the primary rocks. There is an evident diminution of volcanic activity. The vegetable world undergoes a remarkable transformation. Ancient types of plants peculiar to the Carboniferous and Permian formations disappear and are replaced by cone-bearing and more advanced types of trees. This division of the geological record has been styled as "the age of Cycads," a vegetable form already referred to. The vanguard of the rich plant life of to-day appears. Animal life also advances.

The lowest strata are called by geologists the *Triassic* rocks; they overlie and were deposited after the Permian rocks. These layers consist for the most part of bright red sandstone and clays or marls, often ripple-marked, sun-cracked, rain-pitted, and marked with animal foot-prints.

When these rocks were deposited, plant life consisted mainly of ferns, cone-bearers and cycads. A few of the Carboniferous ferns survived. The earliest true horsetails now spring into existence. Calcareous sea-weeds abounded in the open seas of the time.

Foraminifera, sponges and corals are in abundance. Star-fish and their allies are plentiful. Certain localities are rich in fossil sea-urchins, which appeared only sparsely in the Primary rocks. A creature like our living shrimp sprang into existence. Shell-fish progress in complexity of structure. Fish exhibit no advance upon previous formations.

One of the distinctive features of the Triassic system is the remarkable creation of amphibians and reptiles. Wonderful carnivorous reptiles appear, distinguished by having three sets of teeth. Others had no teeth, or but a long tusk-like pair of teeth, the jaws being prolonged into a horny beak. These early reptiles present characters connecting them with birds on one hand and mammals on the other, and the size and unwieldiness of some gave them a resemblance to the elephants and rhinoceroses of modern times. "They appear to have walked mainly on their strong hind legs, the prints of their hind feet occurring in great abundance among the red sandstones of Connecticut. Many of them had three bird-like toes, and left footprints quite like those of birds. Others had four or even five toes, and attained an enormous size, for a single footprint sometimes measures twenty inches in length."[1] The earliest types of crocodiles now are found in these rocks.

The first evidence of Mammalian life, that is, animals which suckle their young, appears in these strata. They were of the lowest type, allies either of the duck-billed platypus, the kangaroo, or opossum.

The Triassic rocks are found in Britain, Scandinavia, in the Western Alps, Asia, Africa, Australia, and North America.

Lying on and deposited after the Triassic rocks is found a series of strata, called by geologists the *Jurassic* rocks. Nearly all over the world are these rocks found.

The plants in this formation are mostly those which

[1] "Text-Book of Geology," Sir Archibald Geikie, F.R.S., 3rd edition, 1893, p. 863.

bore naked seeds, as are found in the pines of the present day. Certain varieties of plant life peculiar to the Permian system have died out. The horse-tail plants are still abundant. Ferns and cycads are the dominant plants.

Shell-fish are abundantly and admirably preserved in these formations, but the lower forms decrease in importance. Oysters are now in abundance, and the modern bivalves and univalves largely predominate over the brachiopods. Corals of modern type are found in these strata. Ammonites, extinct relations of our Nautilus, lived in variety. The ancient trilobites are replaced by long ten-footed lobsters and prawns, the representatives of our modern lobsters. Terrestrial insects flourished, including dragon-flies and may-flies. Also there were cockroaches and grasshoppers, and numerous beetles. Indications of butterfly life appear.

The special types of ganoid fishes that were characteristic of the Primary rocks are now dying out. Rays and sharks, however, still form the most prominent fishes. But the most remarkable feature of these strata is the abundant remains of reptiles. True turtles were created when these layers of rock were deposited. One of the most remarkable sea-lizards was a creature with a fish-like body, two pairs of strong swimming paddles, probably a vertical tail-fin, and a head jointed to the body without any distinct neck, but furnished with two large eyes, having a ring of bony plates round the eyeball, and with teeth that had no distinct sockets. Some of these creatures measured twenty-four feet in length. Another monster had a long neck, large-sized paddles, and smaller head

and the insertion of its teeth in special sockets. Specimens of these creatures measure forty-five feet in length. Another extraordinary form was a flying reptile—huge, winged, bat-like creatures, with large heads, teeth in distinct sockets, eyes with bony plates round the eyeball, and bones like those of birds, hollow and air-filled. One type had a short tail, and jaws furnished from end to end with long teeth. Some types possessed a long tail, and formidable jaws terminating in a horny beak—these strange harpy-like creatures were able to fly, to shuffle on land, to perch on rocks, perhaps even to dive in search of their prey. The long slender teeth which some of them possessed indicate that they lived on fish. These monsters attained, when these strata were formed, their maximum development. Some of the Jurassic reptiles must have weighed about three tons, others reached a height of ten feet and a length of fifty feet. One species of these gigantic creatures had feet which spread out a square yard in area. Some had bony plates on their backs measuring more than three feet in diameter. In America remains of these giants have been found thirty feet or more in height, and with a length of nearly 100 feet.

Now the first bird appears, a creature somewhat smaller than a crow, imitating the characters of a reptile and a bird; thus, it had a long lizard-like tail, each division bearing a pair of quill feathers. The three wing fingers were free, each ending in a claw; there were four toes to each foot as in our common birds. The jaws carried true teeth.

Small marsupials, creatures which deliver immature young, which were nursed in a pouched cavity as in our

kangaroos, were the only mammals, and were therefore the most highly organized creatures existing in these formations. Certain types were akin to the American opossum.

Nevertheless, notice how Nature keeps on progressing from the simple to the complex, from the complex to the more complex, from high to higher structures.

The Jurassic formations are found in Britain, France, Germany, Sweden, Russia, North America, Asia, and Australia.

Lying over and deposited later, upon the Jurassic rocks, are a set of strata, called by geologists the *Cretaceous* rocks. Part of this system is well marked in England, we call the rock, chalk. Plant life is of great interest, as we have the first indications of the higher vegetation living to-day. When these organisms flourished, the climate of Europe was probably warmer than at present. Now remains are found of the oak, willow, beech, plane, poplar, maple, hickory, fig, tulip-tree, sassafras, laurel, cinnamon, buckthorn, together with ferns, American palms, &c.

But the Chalk is exceptionally interesting. It largely consists of perfect but minute calcareous shells—foraminifera. The creatures which secreted these shells from the carbonate of lime, which was held in solution in these ancient seas, consisted of masses of molecules attracted to each other, and we call these masses protoplasm. Marvellously wonderful are the forms this protoplasm takes; occupying the shell, it radiates through minute orifices in it like so many fine hairs in all directions. The object of these processes is to collect food existing in the water. Besides these minute shells there are larger

shells, broken shells and other objects. But we may consider that the principal mass of the chalk is formed of these microscopical creatures—the foraminifera, sometimes to the extent of being ninety per cent. of the chalk deposit. The creatures which secrete these shells exist to this day in our seas, living in the water, born there, growing there, dying there—then their shells gradually fall to the bottom; and thus are they forming a deposit which will be some day the chalk cliffs of a world utterly different in aspect from our present world. What wonderful fossils will be found in those chalk cliffs! Imagine the museums of these coming days with glass cases which hold ironclad steamships with fossil bones of the captain and crew, the cannon and guns of to-day—an exhibition of horror to the intelligent being of that coming time, and telling the record of the barbarism of the present! But it is when we consider the great thickness of this chalk formation, often 800 feet, and that it has been built up of these microscopical creatures; that a time must be allowed for the life history of each shell, and consequently a time for the enormous deposit, a time for the upheaval of the bottom of the sea to become dry land—the chalk formation—and when we further reflect on the subsequent deposition of hundreds of strata upon it, sometimes deposited in sea water, sometimes in fresh water, it is then the mind absolutely stands aghast at the stupendous period required to account for the geological history of the world, a time which appears to us to be eternal.

Corals and sea-urchins, mollusks, some species of which were allied to the squids of to-day, must have

swarmed in some of the Cretaceous seas. But reptiles were not so abundant as in the previous system. True crocodiles frequented the rivers of the period. One extraordinary reptile was of a huge snake-like form, forty or more feet long, with a slim arrow-shaped head, on a swan-like neck, rising twenty feet out of the water. This formidable sea monster "'probably often swam many feet below the surface, raising the head to the distant air for a breath, then withdrawing it and exploring the depths 40 feet below without altering the position of its body. It must have wandered far from land, and that many kinds of fishes formed its food is shown by the teeth and scales found in the position of its stomach' (Cope)."[1] Sea-serpents found in this system measure more than seventy-five feet in length; their heads are large, flat and conic, with eyes directed partly upwards. They swam by means of two pairs of paddles, like the flippers of the whale. Like snakes, they had four rows of formidable teeth. They possessed a unique arrangement in order to swallow their prey entire. Some of the monsters living in these times had skulls exceeding six feet in length, exclusive of the horny beak, and four feet in width. Birds lived, remarkable for having teeth in their beaks, rudimentary wings, powerful hind limbs, and a broad beaver-like tail, which no doubt materially helped in steering the creature through the water. These birds had long flexible necks and powerful jaws, which would enable them to catch the most agile fish. These are a few of the marvellous creatures which lived in the Cretaceous times.

[1] "Text-Book of Geology," Sir Archibald Geikie, F.R.S., 3rd edition, 1893, p. 933.

The Cretaceous formations are found in Britain, France, Belgium, Germany, Switzerland, Russia, India, North America, and Australia.

And thus ends the second book of this wonderful Stone Bible. We now enter the

Third Book of the Stone Bible.

Here we find in certain parts a great gap in the formations; so marked is this hiatus that it is often regarded as one of the greatest breaks in the geological history of our globe. The development of the present distribution of land and sea took place during this period. Some of the most colossal disturbances of the terrestrial crust, of which any record remains, took place during the deposit of the strata of the Tertiary epoch. There is abundant evidence of volcanic activity. There are remarkable evidences of great changes in climate. Judging from the terrestrial vegetation preserved in the strata, we may infer that in England the climate of the oldest Tertiary period was of a temperate character, and afterwards the climate became tropical, even to the centre of Europe and North America. Then the climate became temperate; growing still colder, the climate passed eventually into a phase of extreme cold, when snow and ice extended far south into Europe and North America. Geologists are still entirely at variance as to the cause of all these alterations of climate. Animals and plants in Tertiary times are remarkably varied. The lower forms of plant life diminish in importance, and the hard-wood trees and the evergreens of to-day now succeed them, not by a sudden introduction, for we have seen some of these trees appear in Cretaceous times.

Many forms of shell-fish, which played so large a part in the Secondary formations, now cease. So do the great reptiles, which were dominant in that period. Now those higher animals which suckle their young—the Mammalia—appear in force. Ever an advancing alteration in life, a greater complexity of form. The lowest layers of this system are called by geologists the *Eocene* rocks.

Limestone often several thousand feet in thickness, and formed of disk-like foraminiferal shells, is found in the *Eocene* formation. These coin-shaped shells vary from the size of a mere pin-head to that of the size of a florin or larger. They are made up of whorls or concentric formations, the central part being the first formed, and the shell grew by the deposits of the animal which lived in it. These shells were secreted by a species of protoplasm which, as before stated, most likely consists of living molecules, so minute that the eye of man cannot perceive them, even with the strongest magnifying power. Man, however, sees the mass and he calls it protoplasm. These layers, which we must bear in mind are often thousands of feet thick, are found in Europe and Asia, including China and Japan. These shells again give evidence of such vast time for the formation of the rocks of which they are composed, that the human mind utterly fails in attempting to grasp the apparent infinity of time for the formation of the strata. Not only have we to give time for the growth of each individual shell, but time for the deposit of these shells in water and time for this vast and thick deposit to be upheaved out of the water to become the dry land. The pyramids of Egypt were practically built of these shell-deposits.

And still more remarkable, these organic layers or strata become in places altered into a compact, crystalline, marble-like structure, which can hardly be distinguishable from Primary or the older metamorphic rocks. With this evidence before us, the mind tends to the idea that the materials of some igneous rocks were altered sedimentary rocks, that is, that the materials of the igneous rocks were originally deposited in water and subsequently altered by complete melting.

The plants which existed in the clay, which is so well developed in the neighbourhood of London, known as the London Clay, indicate that the climate was, during its deposition, a warm one. Palms and cacti flourished when the clay was formed. But as we trace subsequent layers, we find that the plant life approaches the English plant life of to-day. Shell-fish existed of the same types as now live in the warmer seas of our globe. Tortoises, turtles, crocodiles, and sea-snakes lived in the rivers and seas which existed where England and Europe are now dry land. Birds lived in variety, and forms, allied to the buzzard, osprey, hawk, quail, pelican, and other existing species, then lived. In the lower formations are found primitive animal-eating or carnivorous mammals. Tapir-like animals, and mammals living on insects, now appear. And also the earliest representatives of the more advanced form of mammal likewise appear—the lemuroid monkeys are created. Creatures between the tapir and the horse spring into existence, having three toes on each foot, and they are regarded as the ancestors of the horse. The remains of numerous hog-like animals, mingled with herds of hornless forms of deer and antelopes, are found in these strata. Animals re-

sembling wolves are found in these layers, as also are found representatives of hedgehogs, squirrels, and bats.

Thus we see, even in this brief and necessarily imperfect record, through vast ages, in which we must recognize an unknown number of millions of years, a time to our minds absolutely infinite, does Nature *gradually* alter its life-forms to a system of organisms which exists at the present day.

The Eocene formations are found in Britain, France and Belgium, South Europe, India, North America, and Australia.

Lying on or over and subsequently deposited is a series of layers or strata called by geologists the *Oligocene* rocks.

The plant life is composed mainly of evergreen plants, linking them with the living tropical plants of India and Australia. Now parroquets, cranes, eagles, grouse, and other birds appear, reminding us of the lake districts in South Africa.

The Oligocene strata are found in Britain, France, Belgium, Germany, Switzerland, Italy, and North America.

Lying upon the above strata and deposited subsequently are formed the layers called by geologists the *Miocene* rocks.

Animal and plant life marched still further to agree with living life. The forests of these times were tenanted by apes—man-like apes, without tails.

The Miocene rocks are found in France, Germany, Italy, Greenland, India, North America, New Zealand, and Australia.

Lying upon the Miocene, and deposited subsequently, is a series of layers called the *Pliocene* rocks; vege-

table life still more approaches modern life forms. The climate appears to have been similar to the climate of to-day. The horse and ass have only one toe, as they at present appear. The ox, cat, bear, fox, beaver and mouse and other living animals existed in these times.

The Pliocene rocks are found in Britain, Belgium and Holland, France, Italy, Germany, Greece, North America, Australia, and New Zealand.

Lying on the above and subsequently deposited are found the rocks called by geologists the Post-Tertiary or the Quaternary rocks. And here commences the

Fourth Book of the Great Stone Bible.

At first the temperate parts of the northern hemisphere became glacial, a condition similar to the North Pole regions. The whole of Northern Europe was buried under ice far south; and, beyond the edge of this huge sheet, every highland became a centre for glaciers which spread far over the lowlands. This occurred even in the heart of France, and the temperate forms of life were destroyed or driven towards Africa. It is estimated that the area of Europe thus buried in ice was not less than 770,000 square miles. In some parts the earth may have been buried beneath ice 6000 to 7000 feet thick. The same Ice age existed in North America. The boulder clay formed during this epoch has given rise to vast deposits. It is believed by some that there were five distinct glacial epochs between which temperate climate intervened. All this information tends to the view that the earth's axis has altered from time to time, so that some new portion of the earth occupied the Arctic region, and

then the same part became a temperate or a far warmer climate.[1] No doubt these alterations were very, very

[1] "That the axis of the Earth's rotation has successively shifted, and consequently that the poles have wandered to different points on the surface of the globe, has been maintained by geologists as the only possible explanation of certain remarkable conditions of climate, which can be proved to have formerly obtained within the Arctic Circle. Even as far north as lat. 81° 45′, abundant remains of a vegetation indicative of a warm climate, and including a bed of coal 25 to 30 feet, have been found *in situ*. It is contended that when these plants lived, the ground could not have been permanently frozen or covered for most of the year with thick snow. In explanation of the difficulty, it has been suggested that the north pole did not occupy its present position, and that the locality where the plants occur lay in more southerly latitudes. . . . we can, without having recourse to any extra-mundane influence, recognise two causes which, whether or not they may suffice to produce any change in the position of the main axis of inertia, undoubtedly tend to do so. In the first place, a widespread upheaval or depression of certain unsymmetrically arranged portions of the surface to a considerable amount would tend to shift that axis. In the second place, an analogous result might arise from the denudation of continental masses of land, and the consequent filling up of sea-basins."—("Text-Book of Geology," Sir Archibald Geikie, F.R.S., 1893, p. 17.)

"We are . . . most interested by the labours of Mr. Chandler, a distinguished American astronomer, who has made an exhaustive examination into the subject. The result has been to prove that the Pole does undergo movement in the body of the earth. Mr. Chandler has been so successful as to have determined the law of those polar movements, and he has found that when they are taken into consideration an important improvement in certain delicate astronomical inquiries is the result. These valuable investigations merit, in the highest degree, the attention, not only of those who are specially devoted to astronomical and mathematical researches, but of that large and ever-increasing class who are anxious for general knowledge with regard to the physical phenomena of our globe."—("In the High Heavens." Sir R. S. Ball, D.Sc., LL.D., F.R.S., 1894, p. 67.)

slow, again giving us some very slight idea of the vast time required to account for geological phenomena.

Animal life during this glacial period was extraordinary. The hairy mammoth and the woolly rhinoceros roamed over Europe and were driven south as the cold increased. The reindeer and Arctic fox travelled as far south as the Pyrenees. And then, when the glacial climate became modified to a warm climate, the leopard, the lion, the African elephant and hippopotamus, appeared to occupy the region which was that of, apparently, eternal snow, and so, by oscillations in climate from extreme cold to heat, would appear a corresponding immigration and emigration of northern and southern types.

All is in a state of change—eternal change. And these changes are particularly shown in Britain, Scandinavia, Germany, France, Belgium, Russia, North America, and Australia.

Subsequently the climate and the earth's surface more nearly approach the condition in which we now find things, and we enter what geologists term,

The Recent or Human Period of the Stone Bible.

Ice still exists, but it is departing, and now man appears upon the scene. He has not left much of the remains of his body. Flint implements, at first rudely chipped, subsequently polished, and then metal implements of peace and war are found. The earlier instruments are found in caves associated with extinct animal life. Remains of the work of man are found with some of the later phases of the Ice age. It is needless to go into the detail of the appearance of Man upon the face

of the earth. Suffice that he appears in existence a creation, geologically speaking, of yesterday, but nevertheless of a time so remote that it is to the human mind, unthinkable—to our minds it is that of infinity or eternity.[1] There are no hard and fast lines to lead

[1] "In accepting, however, the evidence for Tertiary man, we must accept with it conclusions which are much opposed to preconceived opinions. In the two best authenticated instances in which human skulls have been found in presumably Tertiary strata, those of Castelnedolo and Calaveras, it is distinctly stated that they present no unusual appearance, and do not go nearly as far in a brutal or pithecoid direction as the Quarternary skulls of Neanderthal and Spy, or as those of many existing savage races. The Nampa image also appears to show the existence of considerable artistic skill at a period which, if not Tertiary, must be of immense antiquity. How can this be reconciled with the theory of evolution and the descent of man from some animal ancestor common to him and the other quadrumana? Up to a certain point, viz. the earliest Quarternary period, the evidence of progression seems fairly satisfactory. If we take the general average of this class of skulls as compared with modern skulls, we find them of smaller brain-capacity, thicker and flatter, with prominent frontal sinuses, receding foreheads, projecting muzzles, and weaker chins. The brain is decidedly smaller, the average being 1150 cubic centimètres as compared with 1250 in Australians and Bushmen, and 1600 in well-developed Europeans; and of this smaller capacity a larger proportion is contained in the posterior part. (Quatrefages and Hamy, *Crania Ethnica.*) Other parts of the skeleton will tell the same story, and in many of the earliest and most extreme instances, as those of Neanderthal and Spy, a very decided step is made in the direction of the 'missing link.' But if we accept the only two specimens known of the type of Tertiary man, the skulls of Castelnedolo and Calaveras, which are supported by extremely strong evidence, it would seem that as we recede in time, instead of getting nearer to the 'missing link,' we get further from it. This, and this alone, throws doubt on evidence which would otherwise seem to be irresistible, and without a greater number of well-authenticated confirmations we must be content to hold our judgment to a certain extent in suspense.

us to believe that he sprang into existence at one place, but we may rather suppose that he came to stay from many centres. Rude, unkempt, probably hairy like a monkey, living on uncooked food, in caves, a mere beast on the earth's surface—such was the origin of civilized man. Gradually by a process of the survival of the fittest he has altered to become the intelligent being we now find him, able to make huge complex instruments of war and peace, able to girdle the world so that distance is annihilated, able to impress his thoughts in such a way that they can be distributed

This, however, it must be remarked, extends only to the type of man as shown by these two skulls, and does not at all affect the fact that man, of some type or other, did exist in the Pliocene and Miocene periods, which is established beyond reasonable doubt by the numerous instances in which chipped implements and cut bones have been found by experienced observers, and pronounced genuine by the highest authorities.

"All we can say with any certainty is, that if the Darwinian theory of evolution applies to man, as it does to all other animals, and especially to man's closest kindred, the other quadrumana, the common ancestor must be sought very much further back, in the Eocene, which inaugurated the reign of placental mammalia, and in which the primitive types of so many of the later mammals have been found."—("Human Origins," S. Laing, 1895, pp. 388-390.) See latter part of foot-note, page 177.

"The investigations in the bed of the Nile confirm these views. That some unwarranted conclusions have at times been announced is true; but the fact remains that again and again rude pottery and other evidences of early stages of civilization have been found in borings at places so distant from each other, and at depths so great, that for such a range of concurring facts, considered in connection with the rate of earthy deposit by the Nile, there is no adequate explanation save the existence of man in that valley thousands on thousands of years before the longest time admitted by our sacred chronologists."—("A History of the Warfare of Science with Theology in Christendom," A. D. White, 1896, vol. i. p. 263.)

broadcast, able to prognosticate the future from the present. What is his *rôle* in the great Eternity before him?

In this brief and therefore imperfect record of the physical history of our world, largely abstracted from Sir Archibald Geikie's "Text-Book of Geology," the following facts must be always kept steadily in mind. Firstly, the number of distinct layers of deposits is absolutely enormous, and it is not possible to numerically value them. These deposits are of every conceivable material, sometimes clay, then gravel, or sand, or sandstone, or limestone, &c. Sometimes the layers were deposited in salt water—seas or oceans, sometimes fresh water—rivers or lakes. There is only one definite order of formation, the newer is always laid on the older, and thus we are able to trace the order of deposition. Secondly, the organic remains of life which lived on land must of necessity be of the rarest description. Only some accident would permit the bones of land animals, for they are the principal remains, to be deposited in the bed of the waters, and with a few exceptions this is the process by which these remains have been preserved. On the other hand, of the life which lived in water most abundant remains are found. Thirdly, the most important idea to grasp is, every organism except the most simple was built up of cells and the material secreted by these cells. Just as the material of which the shell of an oyster is composed is secreted by the cells—the living composite individual —so were these fossils secreted by living cells. Every cell is an intensely complex group of molecules, every molecule is a group of atoms, and the grouping of these atoms has been the result of the superior power of

the fundamental atom to form the specific molecule. Moreover every organism, except the very lowest class which multiplies by division or budding, has sprung from apparently the most simple of cells, the egg-cell, and in that egg-cell like other cells were the nucleus and the nucleolus.

Now if the mind rests upon the facts, there are only two fundamental ideas that can be grasped to explain them. *First, life recurs by molecular regeneration. Secondly, that regeneration has been going on for a time which appears to the human mind to be absolutely that of eternity.*

But there is yet another still more remarkable fact to observe. The first organisms appear to have been simply little masses of free moving molecules called protoplasm, the next higher stage of life were organisms consisting of cells each with a nucleus and nucleolus,[1] and from these simple forms of life, which would appear to have originated by spontaneous generation,[2] were gradually built up more and more

[1] "If thoughtfully and carefully we consult these most valuable records, we at once perceive what is exceedingly significant, namely, that the lowest and simplest forms of life, the so-called primary plants and primary animals, consist throughout life merely of one simple cell; they are permanently one-celled."—("The History of Creation," Prof. Ernst Haeckel, 1892, vol. ii. p. 40.)

[2] "Life is purely a physical phenomenon. All the phenomena of life depend on mechanical, physical, and chemical causes, which are inherent in the nature of matter itself. The simplest animals and the simplest plants, which stand at the lowest point in the scale of organization, have originated and still originate by spontaneous generation."—(*Idem*, vol. i. p. 115.)

"If the hypothesis of spontaneous generation is not accepted, then we should have at this one point in the theory of development to take refuge in the miracle of a supernatural creation. We should have to

complex organisms, the records of which we find in the various strata of the earth's crust, and the organisms which are living to-day, until we reach the highest animal—*Man*. Now comes the all-important fact, Man himself, you, reader, and every being which has been born, started existence from a similar mass of protoplasm, this altered into a cell having a nucleus and nucleolus—the Egg, and this slowly altered into similar forms, such as have been developed during the time of geological records.[1] Human lungs are a modification of the swimming bladder of fishes. Each man

assume that the first organisms, or the first few organisms from which all the others are derived (at all events, the simplest Monera or primæval cytods), were created as such, and that the Creator conferred upon them the capacity of developing further in a mechanical way. I leave the reader to choose between this miraculous idea and the hypothesis of spontaneous generation. In my opinion the idea that the Creator should have interfered at this one point in the regular course of the development of matter, which otherwise proceeds entirely without His co-operation, must be as unsatisfactory to a credulous as to a scientific mind. If, on the other hand, we assume for the origin of the first organisms the hypothesis of spontaneous generation, which, for reasons discussed above and especially by the discovery of the Monera, has lost its former difficulty, we obtain an uninterrupted, natural connection between the development of the earth and the organisms which it has produced; and, further, we also recognize in the last still doubtful point *the unity of all nature, and the unity of her laws of development*."—(*Idem*, vol. ii. p. 71.)

[1] "The very same marvel actually recurs before our eyes in the short space of nine months, during the embryonic development of each human individual. The same series of multifariously diverse forms, through which our brute ancestors passed in the course of many millions of years, has been traversed by every Man during the first 40 weeks of his individual existence within the maternal body."—("The Evolution of Man," Prof. Ernst Haeckel, 1883, vol. ii. p. 5.)

in his early life-history had gill-like formations like a fish. The embryo of man in its early stages cannot be distinguished from that of a fish, salamander, tortoise, chick, pig, calf, or rabbit.[1]

At one stage of our life history we had a true tail double the length of our legs.[2]

And there is now abundant evidence to show that the present human civilization has arisen from slow alterations in the organic whole—the human being having inherited certain complex structures from the parent, hence the hereditary qualities of the being—*inheritance*, which qualities have been slowly altered through the individual's external conditions by a process called *adaptation*, and this result is mostly obtained by what is now known as the law of *the struggle for existence*.[3]

[1] For striking illustrations see "The Evolution of Man," Prof. Ernst Haeckel, 1883, vol. i. p. 362, plates vi., vii

[2] *Idem*, vol. i. p. 371.

[3] The students of these great factors in human progress cannot do better than study that most interesting work "The History of Creation," by Prof. Ernst Haeckel, from which we have so often quoted.

III.

ON THE SPURIOUS BIBLE.

In contrast to the great Stone Bible written by Nature, or if we like so to call the process, by God, there exists a spurious Bible written by man, and the authors are unknown,[1] in which is recorded the supposed creation of this world and of the universe. This generation and past generations have been educated by the priests in the conception that this Bible is absolutely true. It wants little intelligence to find, from its own inherent qualities, that it cannot be true.

The record states that the universe was created by a being of which we have even now not the slightest conception, and which is called "God."[2]

God, who is described in terms of *an organic being*, is stated to have created out of nothing, in six days, the whole of the universe, of course including the heaven, the earth, the objects in space, stars, &c.

[1] "We criticize it" (The Bible), "freely, and find it to be a collection of various writings of various ages, by unknown or doubtful authors, and containing, with much that is of the highest truth and highest interest, much that bears evident traces of the ignorance, superstition, ferocity, and immorality of the rude and barbarous ages over which its traditions extend."—("Problems of the Future," S. Laing, 1894, p. 292.)

[2] "'God is a blank sheet, upon which nothing is found, but what you have yourself written.'—Luther."—("Force and Matter," Dr. Louis Büchner, 1864, p. 184.)

On the first day—to which all the phenomena of a perfect day is given, that is, one half of the earth was illuminated by a central illuminating body, a sun, giving an evening and a morning—was created the heaven and the earth *and light*, "and there was evening and there was morning, one day." "And God called the light Day, and the darkness he called Night." [1]

Having already created the heaven on the first day, God is stated to have again created the heaven, i.e. the firmament, with the object of dividing the waters which were above from the waters which were below. The conception being that it was necessary to have waters above to permit rain to fall in the future. There is no idea that this reservoir of water would be exhausted in time, and that it must be necessary to replenish it, in order to permit the continuous phenomenon of rain. And this work was the work of the second day. That is, "there was evening and there was morning, a second day."

The earth was supposed to be a mixture of water and the more solid material, the whole may be assumed to be in a condition of mud. It was necessary to divide the water from the mud to allow of the existence of the solid dry land. So God made this division, and he called the dry land, Earth, and the gathering of the waters, Seas. He also created vegetation, which yielded seed, and fruit trees, each tree bearing fruit after its kind. And this was the work of the third day, for "there was evening and there was morning, a third day."

Now comes the very remarkable mistake made by

[1] The quotations from the Bible are from the revised edition.

the writer or writers of this legend. Having already created light and given the phenomena of day and night (for we must remember the evening and morning, with the intervals of night and day together made a whole day), God thought of re-creating the universe thus: he said, "Let there be lights in the firmament of the heaven to divide the day from the night; and let them be for signs, and for seasons, and for days, and years: and let them be for lights in the firmament of the heaven to give light upon the earth." So "God made the two great lights; the greater light to rule the day, and the lesser light to rule the night: he made the stars also." And these lights were "to divide the light from the darkness." "And there was evening and there was morning, a fourth day."

It is obvious that to have made this so-called creation in harmony with the facts—the facts as represented by the Bible—this creation of the sun and moon on the fourth day should have been the creation of the first day.[1]

But when man, a creature so utterly insignificant as

[1] "Now it is absolutely certain that portions of the Bible, and those important portions relating to the creation of the world and of man, are not true, and therefore not inspired. It is certain that the sun, moon, stars, and earth were not created as the author of Genesis supposed them to have been created, and that the first man, whose Palæolithic implements are found in caves and river gravels of immense antiquity, was a very different being from the Adam who was created in God's likeness and placed in the Garden of Eden. It is certain that no universal deluge ever took place since man existed, and that the animal life existing in the world, and shown by fossil remains to have existed for untold ages, could by no possibility have originated from pairs of animals living together for forty days in the ark, and radiating from a mountain in Armenia."—("Modern Science and Modern Thought," S. Laing, 1896, p. 251.)

he is, living on a world which does not even bear the proportion to objects in space of, probably, one grain of sand to the sea-shore, even is this the world's proportion to the objects in space—but when man, we say, supposes that these infinite numbers of bodies in space, many of gigantic size, were created simply for the object of giving light to the earth for man's advantage *only*, why then, man shows such a presumption, such an egotism, that his conceit, arrogance, or assumption is absolutely marvellous.

By photography we are able to discover objects in space which the eye cannot see even by the best instruments. They are not, to our eyes, luminous, they are possibly worlds inhabited as our world is. Astronomers are now making a chart of these bodies in space, and it is estimated that they will number more than one hundred millions[1] of objects. But will the photographic plate record all in the universe? Most certainly not.

On the fifth day God is reported to have created animal life which was to be "fruitful and multiply," and "there was evening and there was morning, a fifth day."

And lastly God created man "in his own image, in the image of God created he him"—*male and female* created he them. And they were to have dominion over every living thing that moveth upon the earth. "And there was evening and there was morning, the sixth day."

On the seventh day it is recorded that God rested from his arduous duties, so he blessed the seventh day and hallowed it.

[1] See page 13, footnote.

Thus finishes the first record of the creation, followed by a second record. This second legend differs from the first in marked degrees.[1] Here we have the legend of the Garden of Eden. Now we find that man was not created "male and female," but the male only—one solitary male was only created "of the dust of the ground."[2] And this poor wretch must have lived a considerable time without any human association, for he was required to dress and keep this Garden of Eden during the time vegetation was flourishing. Then it bethought God of the solitary condition of this poor human creature. "It is not good that the man should be alone," said God; so he caused a deep sleep to fall upon Adam, and

[1] "The two accounts of the creation of the heaven and earth, of animal and vegetable life, and of man, are quite different. In the first Man is created last, male and female, in the image of God, with dominion over all the previous forms of matter and of life, which have been created for his benefit. In the second Man is formed from the dust of the earth immediately after the creation of the heavens and earth and of the vegetable world, and subsequently all the beasts of the field and fowls of the air are formed out of the ground, and brought to Adam to name; while, last of all, woman is made from a rib taken from Adam to be an helpmeet for him."—("Human Origins," S. Laing, 1895, p. 220.)

[2] "This idea of these great fathers of the Eastern Church took even stronger hold on the great father of the Western Church. For St. Augustine, so fettered usually by the letter of the sacred text, broke from his own famous doctrine as to the acceptance of Scripture and spurned the generally received belief of a creative process like that by which a toymaker brings into existence a box of playthings. In his great treatise on *Genesis* he says: 'To suppose that God formed man from the dust with bodily hands is very childish. . . . God neither formed man with bodily hands nor did he breathe upon him with throat and lips.' "—("A History of the Warfare of Science with Theology in Christendom," A. D. White, 1896, vol. i. p. 53.)

while he was asleep he took one of his ribs, out of which he fashioned Woman, the helpmate for Man.[1]

[1] "Feeling, evidently, rather than understanding, induces most people to combat the theory of their 'descent from Apes.' It is simply because the organism of the Ape appears a caricature of Man, a distorted likeness of ourselves in a not very attractive form, because the customary æsthetic ideas and self-glorification of Man are touched by this in so sensitive a point, that most men shrink from recognizing their descent from Apes. It seems much pleasanter to be descended from a more highly developed, divine being, and hence, as is well known, human vanity has, from the earliest times, flattered itself by assuming the original descent of the race from gods or demi-gods. The church, with that sophistical distortion of ideas of which she is so great an adept, has managed to extol this ridiculous pride as Christian humility; and those people who reject with haughty horror every suggestion of descent from lower animals, and consider themselves children of God, those very people are exceedingly fond of boasting about their childlike humility of spirit. In most of the sermons delivered against the progress of the doctrine of evolution, human vanity and conceit play throughout a prominent part; and, although we have inherited this characteristic weakness from Apes, yet we must confess to having developed it to a degree of perfection which completely overthrows the unprejudiced judgment of the 'sound understanding of man.' We ridicule the childish follies occasioned by the pride of ancestry among the nobility, from the splendid Middle Ages down to our own time, and yet no small portion of this groundless pride of nobility lurks in a great majority of men. Just as most people prefer to trace their pedigree from a decayed baron or, if possible, from a celebrated prince, rather than from an unknown, humble peasant, so they prefer seeing the progenitor of the human race in an Adam degraded by the Fall, rather than in an Ape capable of higher development and progress. It is a matter of taste, and such genealogical preferences do not, therefore, admit of discussion. Still, I must confess that, personally, I am as proud of my paternal grandfather, who was simply a Silesian peasant, as of my maternal grandfather, who raised himself from the position of a Rhenish lawyer to the highest posts in the council of state. And it is also much more to my individual taste to be the more highly developed descendant of a primæval Ape ancestor, who, in the struggle for

And this is the absolutely childish tale the nineteenth century is taught to believe by priestcraft!

Then comes the absurd legend of the Serpent tempting man.[1] We have no idea what sort of creature this serpent was, only that he was apparently a being which had limbs, because the curse of God after his successful temptation of Eve and Adam was, that he should move only upon his belly.

Now what is the record of this temptation? God

existence, had developed progressively from lower Mammals, as they from still lower Vertebrates, than the degraded descendant of an Adam, god-like, but debased by the Fall, who was formed from a clod of earth, and of an Eve, created from a rib of Adam. As regards this celebrated 'rib,' I must here expressly add as a supplement to the history of the development of the skeleton, that the number of ribs is the same in man and in woman."—("The Evolution of Man," Prof. Ernst Haeckel, 1883, vol. ii. p. 445.)

[1] "From the Assyrian researches as well as from other sources, it has come to be acknowledged by the most eminent scholars at the leading seats of Christian learning that the accounts of creation with which for nearly two thousand years all scientific discoveries have had to be 'reconciled'—the accounts which blocked the way of Copernicus, and Galileo, and Newton, and Laplace—were simply transcribed or evolved from a mass of myths and legends largely derived by the Hebrews from their ancient relations with Chaldea, rewrought in a monotheistic sense, imperfectly welded together, and then thrown into poetic forms in the sacred books which we have inherited."—("A History of the Warfare of Science with Theology in Christendom," A. D. White, 1896, vol. i. p. 22.)

"I have dwelt at some length on the ancient religions, for nothing tends more to open the mind, and break down the narrow barriers of sectarian prejudice, than to see how the ideas which we have believed to be the peculiar possession of our own religion, are in fact the inevitable products of the evolution of the human race from barbarism to civilization, and have appeared in substantially the same forms in so many ages and countries."—("Human Origins," S. Laing, 1895, p. 131.)

was walking in the Garden of Eden, like a human being, enjoying the cool of the day, and suddenly he missed Adam and Eve, for they had hidden themselves. So God sought them out and found they had been eating of the fruit of a certain tree which God had prohibited, and for this deadly sin Adam and Eve were cursed, even the ground was cursed, for "cursed is the ground for thy sake: in toil shalt thou eat of it all the days of thy life," and so on. And this is the curse which priests have made us believe is a curse upon *the whole* of the human race. And upon this childish and silly legend do the priests establish the crime of original sin![1]

[1] "Apart from statistics, however, the Books of the Pentateuch ascribed to Moses are full of the most flagrant contradictions and absurdities. It is evident that, instead of being the production of some one contemporary writer, they have been compiled and edited, probably many times over, by what I have called the 'scissors and paste method,' of clipping out extracts from old documents and traditions, and piecing them together in juxtaposition or succession, without regard to their being contradictory or repetitions.

"Thus in Exodus xxxiii. 20, God says to Moses: 'Thou canst not see my face and live; for there shall no man see me and live'; and accordingly he shows Moses only his 'back parts'; while in ver. 11 in the very same chapter we read, 'And the Lord spoke unto Moses face to face, as a man speaketh unto a friend.' Again, in Exodus xxiv., the Lord says to Moses, 'that he alone shall come near the Lord' (ver. 2), while in vers. 9-11 of the same chapter, we are told that 'Moses, Aaron, Nadab, and Abihu, and seventy of the elders of Israel went up; and they saw the God of Israel, and there was under his feet as it were a paved work of a sapphire stone,' and although they saw God, were none the worse for it, but survived and 'did eat and drink.' Is it possible to believe that these excessively crude representations of the Deity, and these flagrant inconsistencies, were all written at the same time, by the same hand, and that the hand of a man who, if not a holy inspired prophet, was at any rate an

And so man was cast from the Garden of Eden. Here we must recollect there were at first but two

educated and learned ex-priest of Hieropolis, skilled in all the knowledge of the Egyptians?

"The contradictions in the ideas and precepts of morality and religion are even more startling. These oscillate between the two extremes of the conception of the later prophets of a one Supreme God, who loves justice and mercy better than sacrifice, and that of a ferocious and vindictive tribal god, whose appetite for human blood is as insatiable as that of the war-god of the Mexicans. Thus we have, on the one hand, the commandment, 'Thou shalt do no murder,' and on the other, the injunction to commit indiscriminate massacres. A single instance may suffice. The 'Book of the Law of Moses' is quoted in 2 Kings xiv. as saying, 'The fathers shall not be put to death for the children, nor the children for the fathers; but every man shall be put to death for his own sin.' In Numbers xxxi., Moses, the 'meekest of mankind,' is represented as extremely wroth with the captains who, having warred against Midian at the Lord's command, had only slaughtered the males, and taken the women of Midian and their little ones captives; and he commands them to 'kill every male among the little ones, and every woman that hath known man by lying with him; but all the women children that have not known man by lying with him, keep alive for yourselves.' . . . The same injunction of indiscriminate massacre in order to escape the jealous wrath of an offended Jehovah is repeated, over and over again, in Joshua and Judges, and even as late as after the foundation of the Monarchy, we find Samuel telling Saul in the name of the Lord of Hosts, to 'go and smite Amalek, and utterly destroy them, slaying both man and woman, infant and suckling, ox and sheep, camel and ass,' and denouncing Saul, and hewing Agag in pieces before the Lord, because this savage injunction had not been literally obeyed. Even under David, the man after the Lord's own heart, we find him torturing to death the prisoners taken at the fall of Rabbah, and giving up seven of the sons of Saul to the Gibeonites to be sacrificed before the Lord as human victims. It is one of the strangest contradictions of human nature that such atrocious violations of the moral sense should have been received for so many centuries as a divine revelation, rather than as instances of what may be more appropriately called 'devil worship.'

"Nor is it a less singular proof of the power of cherished prepos-

human individuals living. Now Adam and Eve had two children, Cain and Abel, and Cain slew Abel. This was the first reputed murder. Here comes the funny part of the legend. Cain gets a wife. Where did she come from? There were only three human beings living, viz., Adam, Eve and Cain—Abel being dead. And thus we have the reputed elements of the whole human race. A tale absolutely childish, a tale which fundamentally contradicts itself. How is it possible for the priests to believe in it, with the modern information pressing upon them at every point?

And more than this. This deadly sin of Adam, namely, eating an apple, and the consequent curse, a curse which is supposed to alight upon every one, are the excuses for a redemption. *If original sin is false, redemption is false.* Now the whole of the teaching of the true Stone Bible, a bible not made by hands, contradicts the legend written by man. It says in the most emphatic way, *the legend is not true, and when this is so, to teach this legend as truth, is* A WICKED PERNICIOUS LIE. What must we say then of priests who attempt to fossilize the mind within the limits of this grand *lie?—a lie which is condemned, i.e. damned.*[1]

sessions that such a medley of the sublime religious ideas and lofty poetry of the prophetic ages, with such a mass of puerile and absurd legends, such obvious contradictions, and such a number of passages obviously dating from a later period, should be received by many men of intelligence, even to the present day, as the work of a single contemporary writer, the inspired prophet Moses."—("Human Origins," S. Laing, 1895, p. 254-256.)

Still more remarkable is the fact that such nonsense should be the product of University education, and that those holding such ridiculous ideas should demand to teach the rising generation!

[1] "Physical science, researches into history, a more thorough

We now know that the Bible is the repeat in a more or less perfect manner, of myths of very high antiquity.[1] Great men have exposed these self-evident contradictions in the Bible, so it is not necessary we should continue them. We only want to state sufficient to lead up to a certain definite issue. This issue is, "What is Religion?"

knowledge of the world they inhabit, have enlarged our philosophy beyond the limits which bounded that of the Church of the Fathers. And all these have an influence, whether we will or no, on our determinations of religious truth. There are found to be more things in heaven and earth than were dreamt of in the patristic theology."—"The Education of the World," by "*The Most Reverend Father in God*" ! ! ! The Archbishop of Canterbury. Is it not wonderful that an intelligent mind which could write the above pregnant words could prostitute himself to the mediæval mummery which has just taken place, and this in the latter part of the nineteenth century?

[1] "All advanced and civilized communities have had their Decalogues and Sermons on the Mount, and it is impossible for any dispassionate observer to read them without feeling that in substance they are all identical, whether contained in the Egyptian Todtenbuch, the Babylonian hymns, the Zoroastrian Zendavesta, the sacred books of Brahmanism and Buddhism, the Maxims of Confucius, the Doctrines of Plato and the Stoics, or the Christian Bible."—"Human Origins," S. Laing, 1895, p. 132.)

IV.

WHAT IS RELIGION?

We have now arrived at the most momentous question, "What is Religion?" The answer comes clear: we do not know. "The difficulty of framing a correct definition of religion is very great."[1]

Mr. Kidd quotes the following as a few of the

Current definitions of Religion.[2]

"*Seneca.*—To know God and imitate Him.

Kant.—Religion consists in our recognising all our duties as Divine commands.

Ruskin.—Our national religion is the performance of Church ceremonies, and preaching of soporific truths (or untruths) to keep the mob quietly at work while we amuse ourselves.

Matthew Arnold.—Religion is morality touched by emotion.

Comte.—The Worship of Humanity.

Alexander Bain.—The religious sentiment is constituted by the Tender Emotion, together with Fear, and the sentiment of the Sublime.

[1] "Chambers's Encyclopædia," 1891, article "Religion."

[2] "Social Evolution," Benjamin Kidd, 1895, p. 96.

Edward Caird.—A man's religion is the expression of his ultimate attitude to the Universe, the summed-up meaning and purport of his whole consciousness of things.

Hegel.—The knowledge acquired by the Finite Spirit of its essence as an Absolute Spirit.

Huxley.—Reverence and love for the Ethical idea, and the desire to realise that ideal in life.

Froude.—A sense of responsibility to the Power that made us.

Mill.—The essence of Religion is the strong and earnest direction of the emotions and desires towards an ideal object, recognised as of the highest excellence, and as rightly paramount over all selfish objects of desire.

Gruppe.—A belief in a State or in a Being which, properly speaking, lies outside the sphere of human striving and attainment, but which can be brought into this sphere in a particular way, namely, by sacrifices, ceremonies, prayers, penances, and self-denial.

Carlyle.—The thing a man does practically believe; the thing a man does practically lay to heart, and know for certain, concerning his vital relations to this mysterious Universe and his duty and destiny therein.

The Author of "Natural Religion."—Religion in its elementary state is what may be described as habitual and permanent admiration.

Dr. Martineau.—Religion is a belief in an everlasting God; that is, a Divine mind and will, ruling the Universe, and holding moral relations with mankind."

Such definitions may be quoted almost indefinitely.

But the Christian Religion *as practised in civilized Christian countries may be stated thus:*

Idealistic.—First, to create an ideal which cannot be defined and call it God, to love this ideal with all the heart and soul and mind, and to worship it. More especially to flatter it by telling God how great, good, and omnipotent he is.[1] *And secondly, to do unto others as we would be done by.*

[1] "God is an ideal of the mind. . . . To worship the image made of ideas is to worship the work of the human brain. God-worship, therefore, is idolatry.

"The God of this country is called a God of love; but it is said that he punishes the crimes and even the errors of a short and troubled life with torture which will have no end. It is not even a Man which theologians create; for no man is quite without pity; no man, however cruel he might be, could bear to gaze for ever on the horrors of the fire and the rack; no man could listen for ever to voices shrieking with pain, and ever crying out for mercy and forgiveness."—("The Martyrdom of Man," Winwood Reade, 1890, pp. 434, 435.)

"However sublime the former idea of a Creator, and his creative power, may have been; however much it may be divested of all human analogy, yet in the end this analogy still remains unavoidable and necessary in the teleological conception of Nature. In reality the Creator must himself be conceived of as an organism, that is, as a being who, analogous to man, even though in an infinitely more perfect form, reflects on his constructive power, lays down a plan of his mechanisms, and then, by the application of suitable materials, makes them answer their purpose. Such conceptions necessarily suffer from the fundamental error of *anthropomorphism*, or man-likening. In such a view, however exalted the Creator may be imagined, we assign to him the human attributes of designing a plan, and therefrom suitably constructing the organism." . . . "If we closely examine the common life and the mutual relations between plants and animals (man included), we shall find everywhere, and at all times, the very opposite of that kindly and peaceful social life which

Practical.—In the main—to take advantage of every action of others, to profit by these actions, to advance one's position by every available means, and especially to take advantage of the ignorance and weakness of others. To buy at the cheapest and to sell at the dearest, with the necessary result of such a system to the weakest—sweating. In a word, NOT to do to others as we would be done by.

Atonement.—To open a ledger account with the ideal—God. Wherein in six days the sins accumulate, this is the credit side of the account. To balance this account by the debit of so many prayers, confessions, and ostentatious ceremony on the seventh day.

And then home, dinner and dessert, and a confident feeling that the whole duty of man has been performed. And then another six days' sin and so on.

This is religion[1] as practised in the nineteenth

the goodness of the Creator ought to have prepared for his creatures —we shall rather find everywhere a pitiless, most embittered *Struggle of All against All.*"—("The History of Creation," Prof. Ernst Haeckel, 1892, vol. i. pp. 18-20.)

"The divine Creator is degraded to the level of an idealized man, of an organism progressing in development. According to this low conception God is, in fact, nothing more than a 'gaseous vertebrate.'" —(*Idem*, p. 71.)

[1] "The current religion is indirectly adverse to morals, because it is adverse to the freedom of the intellect. But it is also directly adverse to morals by inventing spurious and bastard virtues. One fact must be familiar to all those who have any experience of human nature. A sincerely religious man is often an exceedingly bad man. Piety and vice frequently live together in the same dwelling, occupying different chambers, but remaining always on the most amicable terms. Nor is there anything remarkable in this. Religion is merely loyalty: it is just as irrational to expect a man to be virtuous because he goes to church, as it would be to expect him to be virtuous because he went to court. His king, it is true, forbids immorality and fraud.

century by Christians. *It is fetishism without a fetish, idolatry without an idol, or if there is a fetish it is the Bible.*[1] The ignorant who believe in idols and fetishes, punish their gods when they do not act in the way desired; we, because our God is not tangible, cannot do this, but we do the next thing in conceiving another ideal, the devil, whose business it is to control, oppose and punish God! And so all our wrong-doings are the works of a devil. What a satire all this is on human intelligence!

But the chief virtues required are of the lickspittle denomination—what is called a humble and contrite heart. When a Christian sins as a man, he makes compensation as a courtier. When he has injured a fellow-creature, he goes to church with more regularity, he offers up more prayers, he reads a great number of chapters in the Bible, and so he believes that he has cleared off the sins that are laid to his account. This, then, is the immorality of religion as it now exists. It creates artificial virtues and sets them off against actual vices."—("The Martyrdom of Man," Winwood Reade, 1890, p. 533.)

[1] "To the evolution of science, there was developed something in many respects more destructive; and this was the influence of mystic theology, penetrating, permeating, vitiating, sterilizing nearly every branch of science for hundreds of years. Among the forms taken by this development in the earlier Middle Ages we find a mixture of physical science with a pseudo-science obtained from texts of Scripture. In compounding this mixture, Jews and Christians vied with each other. In this process the sacred books were used as a fetich; every word, every letter, being considered to have a divine and hidden meaning. By combining various scriptural letters in various abstruse ways, new words of prodigious significance in magic were obtained, and among them the great word embracing the seventy-two mystic names of God—the mighty word '*Schemhamphoras*.' Why should men seek knowledge by observation and experiment in the book of Nature, when the book of Revelation, interpreted by the Kabbalah, opened such treasures to the ingenious believer?"—("A History of the Warfare of Science with Theology in Christendom," A. D. White, 1896, vol. i. p. 395.)

Now what is the so-called Christian religion—whence does it come?

We know very little about the founder of this religion. Numerically the Christian religion is a fraction of other religions.

The number of individuals professing religion of some sort or other is estimated at about 1,480,000,000.

Of this vast number of individuals the various Christians are about 327,000,000, or somewhat less than one fourth. If these are only those who are to be saved, how reckless the ideal-God, is in damning!

"The sources of our knowledge of the life of Jesus Christ are almost exclusively biblical."[1] The best Jewish historian does not mention him, and arises the question, "May we rely on the four gospels as authentic and adequate?"[2] The gospels are part of that Bible we have shown to be so defective that it cannot be true.[3] *The very reason for the existence of*

[1] "Chambers's Encyclopædia," 1890, article "Jesus Christ."

[2] *Idem.*

[3] "It may, indeed, be now fairly said that the thinking leaders of theology have come to accept the conclusions of science regarding the origin of language, as against the old explanations by myth and legend. The result has been a blessing both to science and to religion. No harm has been done to religion; what has been done is to release it from the clog of theories which thinking men saw could no longer be maintained. . . . Nor has any harm been done to the Bible. On the contrary, this divine revelation through science has made it all the more precious to us. In these myths and legends caught from earlier civilizations we see an evolution of the most important religious and moral truths for our race. Myth, legend, and parable seem, in obedience to a divine law, the necessary setting for these truths, as they are successively evolved, ever in higher and higher forms. What matters it, then, that we have come to know that the accounts of Creation, the Fall, the Deluge, and much else in our sacred books,

the New Testament is withdrawn directly the fall of man and original sin are found to be myths.

But what is the origin of the New Testament? The origin of the books contained in the canonical New Testament is obscure. Previous to the Nicene Council

were remembrances of lore obtained from the Chaldeans? What matters it that the beautiful story of Joseph is found to be in part derived from an Egyptian romance, of which the hieroglyphs may still be seen? What matters it that the story of David and Goliath is poetry; and that Samson, like so many men of strength in other religions, is probably a sun-myth? What matters it that the inculcation of high duty in the childhood of the world is embodied in such quaint stories as those of Jonah and Balaam? The more we realize these facts, the richer becomes that great body of literature brought together within the covers of the Bible. What matters it that those who incorporated the Creation lore of Babylonia and other Oriental nations into the sacred books of the Hebrews, mixed it with their own conceptions and deductions? What matters it that Darwin changed the whole aspect of our Creation myths; that Lyell and his compeers placed the Hebrew story of Creation and of the Deluge of Noah among legends; that Copernicus put an end to the standing still of the sun for Joshua; that Halley, in promulgating his law of comets, put an end to the doctrine of 'signs and wonders'; that Pinel, in showing that all insanity is physical disease, relegated to the realm of mythology the witch of Endor and all stories of demoniacal possession; that the Rev. Dr. Schaff, and a multitude of recent Christian travellers in Palestine, have put into the realm of legend the story of Lot's wife transformed into a pillar of salt; that the anthropologists, by showing how man has risen everywhere from low and brutal beginnings, have destroyed the whole theological theory of 'the fall of man'? Our great body of sacred literature is thereby only made more and more valuable to us: more and more we see how long and patiently the forces in the universe which make for righteousness have been acting in and upon mankind through the only agencies fitted for such work in the earliest ages of the world—through myth, legend, parable, and poem."—("A History of the Warfare of Science with Theology in Christendom," A. D. White, 1896, vol. ii. p. 207.)

other books were part of the received books. Ancient authorities are neither agreed with respect to the time nor place at which this council assembled. It is reported that about 318 bishops attended. The first thing they did was to quarrel, and to present accusations against each other. There is no record of their decision. It is uncertain whether the books of the New Testament were declared canonical by the Nicene Council or by some other, or when or by whom they were collected into a volume. Thus there is no evidence as to when and how the books called the "Apocryphal New Testament" were rejected.[1] But he who possesses the apocryphal New Testament and the canonical New Testament has, in the two volumes, a collection of all the historical records of Jesus Christ and his apostles now in existence and considered sacred by Christians during the first four centuries after his birth.[2] Anyone who will take the rejected books and read them will be surprised at the silly tales they contain. But when these tales are compared with those which are

[1] "At length, by a sort of law of the survival of the fittest, the present Gospels acquired an increasing authority and superseded the other works which had competed with them; but the selection was determined to a great extent, not by those principles of criticism which would now be applied to historical records, but by doctrinal considerations of the support they gave to prevalent opinions. In other words, orthodoxy and not authenticity was the test applied, and it is probable that no Christian Father of the second or third century would have hesitated to reject an early manuscript traceable very clearly to an Apostle, in favour of a later compilation of doubtful origin, if the former contained passages which seemed to favour heretical views, while the latter omitted those passages, or altered them in a sense favourable to orthodoxy."—("Modern Science and Modern Thought," S. Laing, 1896, p. 273.)

[2] The Apocryphal New Testament. William Hone, 1820, preface.

received as canonical, one finds that they differ only slightly in degree.

Faith is the fundamental key-note of the Christian religion. Without faith the religion ceases. Have we that faith? If we have not, then the Christian religion to us is a delusion. It is worse, it is a wicked and pernicious excuse for evil-doing.

The basis of the Christian teaching is built upon miracles. No miracle ever existed.[1] For those who understand the laws of Nature, know well, they are immutable, perfect, eternal. All miracles are departures from the laws of Nature.

Now fortunately the existence of miracles and of faith is capable of experiment, and this experiment we commend to every thoughtful mind. For it is written: "If ye have faith as a grain of mustard seed, ye shall say unto this mountain, Remove hence to yonder place; and it shall remove; and nothing shall be impossible unto you."[2] "All things are possible to him that believeth."[3]

To remove a mountain is a too severe test of faith, we will not require such a one. Let us select a large

[1] "It must equally in candour be admitted that the miracle did not consist in placing man and woman upon earth, at any recent period, or with faculties in any way developed, but could only have consisted in causing a germ or germs to come into existence, different from any that could have been formed by natural evolution, and containing within them the possibilities of conscious and civilized man, to be developed from the rudest origins by slow and painful progress over countless ages."—("Modern Science and Modern Thought," S. Laing, 1896, p. 210.)

[2] The Gospel according to St. Matthew, chap. 17, ver. 20, Revised edition.

[3] St. Mark, chap. 9, ver. 23.

field. In its centre erect a little mound of earth not larger than a mole-hill. Erect an open ring fence 100 yards away from the little mass of earth, so that it is the centre of the ring. Let all the priests of all denominations come, and outside that ring let them exercise their faith—the issue is not a mean one—on it the Christian belief hangs or falls. Let them bring all their apparatus—their altars, their incense, their holy water, their candles, their prayer books and their Bibles, their vestments and their relics; let them bring every spiritual power within their reach, and attempt to move that mound of earth a fraction of distance, that is, by faith—but hands off—and the victory of Christianity is gained. In a sceptical age, when every conceivable question is being sifted by intelligent minds, how vastly important it is that the priests should accept this challenge, and thus remove the pregnant doubts of earnest thinkers and prove both miracles and their faith. If the religious teachers of mankind have not faith, how deplorable is the condition of the religious world! For out of their own mouths they stand condemned. The members of the religious world, that is, the Christian section, claim to be "the salt of the earth: but if the salt have lost its savour, wherewith shall it be salted? it is thenceforth good for nothing, but to be cast out and trodden under foot of men."[1] If the priests dare not accept such a test, then they are blind guides, "and if the blind guide

[1] "Christians believe themselves to be the aristocracy of heaven upon earth; they are admitted to the spiritual court, while millions of men in foreign lands have never been presented. They bow their knees and say that they are miserable sinners, and their hearts rankle with abominable pride. Poor infatuated fools! Their servility is

the blind, both shall fall into a pit." When we see and hear the vain repetitions, the hypocrisy, and the ostentatious apparel—for the priests enlarge the borders of their garments and love the chief places at feasts and the chief seats in the churches, then we know that they are but the successors of a school that it was the avowed object of Jesus Christ to condemn. If miracles are not true, then must the great mass of the reputed acts of Jesus Christ be interpolations of a crafty priesthood.

That there was such a one as Jesus Christ there can be little doubt—that his *rôle* was short was probable. That he taught an enlightening, sympathizing, altruistic religion is undoubted; that he commanded us to look for the future on this earth for a better condition of things is equally true. And does not science do the same? There is good evidence that he taught pure philosophy, and all over and above that has been the addition of the priests, a body of men he condemned in the most telling and forcible manner.

"Thy kingdom *come*. Thy will be done as in heaven so *on earth*," is a true conception. When we have knowledge we obey the teaching of Nature—this points

real, and their insolence is real, but their king is a phantom and their palace is a dream."

"The man who leads a truly religious life in order to go to heaven is not more to be admired than the man who leads a regular and industrious life in order to make a fortune in the city; and the man who endeavours to secure a celestial inheritance by going to church, and by reading chapters in the Bible, and by having family prayers, and by saying grace in falsetto with eyes hypocritically closed, is not above the level of those who fawn and flatter at oriental courts in order to obtain a monopoly or an appointment."—("The Martyrdom of Man," Winwood Reade, 1890, pp. 534, 535.)

to a *terrestrial future*, a better condition of things than the present.

To "consider the lilies of the field, how they grow; they toil not, neither do they spin," and to know that "even Solomon in all his glory was not arrayed like one of these," or, better expressed: to consider the flowers of the field how they grow, and to know that royalty in all its grandeur is not arrayed like one of these, is true science and true religion, and may be translated into the words, to consider the growth of the merest speck, just visible by the highest power of the most powerful microscope, and watch how it grows by its *own inherent power* to become a reasoning intelligent human being, is the height of religion as taught by science and by Jesus Christ, for it differs only in degree from the conception of the study of how the lilies grow.

No—the priests must alter the *rôle* they have elected, or they are doomed. They cannot withstand the growing intelligence of the masses, especially of that lower order which have the instruments of education and a free press at their command, and who have no inducement to sympathize with the religious and power-holding classes. Are these powers capable of progress, and can they alter to adapt themselves to the signs of the times? This is the serious question of the hour. Is it, as of old, impossible to put new wine into old wine-skins, and will the old skins burst and the wine be spilled? Or must we put new wine into fresh wine-skins, and both are preserved? If the latter must be, then is the revolution serious.

The kingdom of Heaven or of God is the kingdom

of knowledge, and it exists only *within us*. And knowledge shows that Nature (or if we like to call Nature—God) maketh the sun to rise on the evil and the good, and sendeth rain on the just and the unjust —in a word Nature works by natural laws, and not by exceptions—miracles. To suppose that evil falls upon the wicked is absurd; we see that which we think is evil flourishing, and the good despised. Or that "those eighteen, upon whom the tower in Siloam fell, and killed them, think ye that they were offenders above all the men that dwell in Jerusalem?" This is a recognition of the grand principle that God or Nature does not deal with the individual, but with all-reaching omnipotent, fixed and eternal laws.

The kingdom of knowledge is a growth, the result of a higher or more complex brain organism in the aggregate. For the kingdom of knowledge cometh not with observation. Hence, until that mental growth has reached an efficient stage it has been full of hazard to teach the kingdom of knowledge, for if we cast our pearls before swine they trample them under their feet and turn to rend us. Thus Galileo and other pioneers of science have suffered. The conditions now, however, are altered; human intelligence is ascending. When the higher reasoning powers are brought forth in the human being, and when the individuals having these powers are sufficiently numerous, they speak with overwhelming force, and the weak and the vacillating will follow this overwhelming opinion. This power is commencing to appear in no uncertain terms, and if priestcraft will not bend, then must the inheritance of the priests be taken away from them

and for ever.[1] The kingdom of knowledge is what intelligent men recognize as the knowledge of the ever ruling natural laws.[2]

The kingdom of knowledge therefore may be likened to the parable[3] of the ten virgins, for five possessed knowledge and five were ignorant of knowledge; and when the cry came, figuratively expressed, that the

[1] "What the greatest thinkers think to-day, the mass of thinkers will think to-morrow, and the great army of non-thinkers will assume to be self-evident the day after. This is very nearly the case at the present day; the great thinkers have gone before, the mass of thinkers have followed, and the still greater mass of non-thinkers are wavering and about to follow. It is no longer, with those who think at all, a question of absolute faith against absolute disbelief, but of the more or less shade of 'faintness' with which they cling to the 'larger hope.'"—("Modern Science and Modern Thought," S. Laing, 1896, p. 219.)

[2] "We can conquer nature only by obeying her laws, and in order to obey her laws we must first learn what they are. When we have ascertained, by means of Science, the method of nature's operations, we shall be able to take her place and to perform them for ourselves. When we understand the laws which regulate the complex phenomena of life, we shall be able to predict the future as we are already able to predict comets and eclipses and the planetary movements."—("The Martyrdom of Man," Winwood Reade, 1890, p. 513.)

[3] "I think the sayings and parables may generally be taken as authentic. It is true that many of both may be found in the literature of the Talmud and of older religions, but this does not negative the probability that Jesus may have used them in his popular addresses, and at any rate they afford a view of what his doctrine and style of preaching really were; and many of the parables and shorter sayings are just such things as would be readily retained in the memory and transmitted by oral tradition."—("Problems of the Future," S. Laing, 1894, p. 259.)

It is very important to remember that Jesus Christ taught by parables "because seeing they see not and hearing they hear not, neither do they understand."

bridegroom had come, the wise entered into power, and the ignorant were cast out.

The priests fossilize thought. They shut up the kingdom of knowledge against men—they neither enter themselves, nor suffer them that are entering in to enter.[1]

When men ask of priests mental bread, they are given a stone; only empty ritual, vain prayers.

How true is this kingdom of knowledge as gradually unfolded by science. Nature responds by observation and experiment; when we speak to Nature we seek and we find, we knock and it is opened unto us, and see the results of knowledge: the blind see, the deaf hear, the lame walk, and disease is being cured, all—all, by the patient observations of Nature and the natural laws.[2]

[1] "It is a remarkable and interesting fact that the two sides in this conflict, even under all the forms and freedom of modern life where the fullest scope is allowed for every kind of inquiry, still seem to recognise each other intuitively as opponents. Mr. Galton, as the result of his inquiries into the personal and family history of scientific men in England, says that it is a fact that, in proportion to the pains bestowed on their education, sons of clergymen rarely take the lead in science. The pursuit of science, he considers, must be uncongenial to the priestly character. He says that in his own experience of the councils of scientific societies it is very rare to find clergymen thereon. Out of 660 separate appointments clergymen held only sixteen, or one in forty, and these were in nearly every case attached to subdivisions of science with fewest salient points to jar against dogma.—*English Men of Science, their Nature and Nurture*, by F. Galton."—("Social Evolution," Benjamin Kidd, 1895, p. 103.)

[2] "Modern civilization rests upon physical science; take away her gifts to our own country, and our position among the leading nations of the world is gone to-morrow; for it is physical science

These laws are patent, self-evident—they are not the creations of man.

And so also is the progress of the kingdom of knowledge. The brain must be sufficiently altered and improved for it to understand the truth. This is the development which is being forced upon us. The progress of knowledge is like the parable of the sower who went forth to sow; and as he sowed some seeds fell by the wayside, and the birds came and devoured them: and others fell upon rocky places, where they had not much earth: and straightway they sprang up because they had no deepness of earth: and when the sun was risen, they were scorched; and because they had no root they withered away. And others fell upon the thorns; and the thorns grew up, and choked them: and others fell upon good ground, and yielded fruit, some a hundredfold, some sixty, some thirty. Yes, the kingdom of knowledge is the appreciation of truth; the appreciation of truth is the seed sown by the sower,

only, that makes intelligence and moral energy stronger than brute force.

"The whole of modern thought is steeped in science; it has made its way into the works of our best poets, and even the mere man of letters, who affects to ignore and despise science, is unconsciously impregnated with her spirit, and indebted for his best products to her methods. I believe that the greatest intellectual revolution mankind has yet seen is now slowly taking place by her agency. She is teaching the world that the ultimate court of appeal is observation and experiment, and not authority; she is teaching it to estimate the value of evidence; she is creating a firm and living faith in the existence of immutable moral and physical laws, perfect obedience to which is the highest possible aim of an intelligent being."—("Lay Sermons, Addresses, and Reviews," T. H. Huxley, LL.D., F.R.S., 1893, p. 101.)

and truth can only be ascertained by experiment. It is not given to many to sow this seed; and when men's minds are not prepared to receive truth the results are barren, and because there is not depth of mind to accept truth there can be no harvest. And thus do the seeds of truth get sown broadcast by the wayside; some accept it, and others do not want it. The rich and those in power prefer to support rotten institutions rather than seek the truth, for the care of the world and the deceitfulness of riches choke the truth and it becomes unfruitful. How hard it is for those who trust in riches to enter into the kingdom of knowledge!

Again, the kingdom of knowledge is like unto leaven, which a woman took, and hid in three measures of meal, till it was all leavened. So do new discoveries of truth permeate through intelligent minds.

That the priests teach the nonsense they do in the nineteenth century is amazing. It is more than amazing, *it is horrible.* Why the very stones of which their cathedrals, churches, and chapels are built bear testimony against them. The priests lay grievous burdens upon the community. Woe unto you, said Jesus Christ, for the priests of to-day are the same as the priests, scribes, and pharisees of old—Woe unto you, hypocrites, for ye devour widows' houses, and for a pretence make long prayers; therefore ye shall receive the greater condemnation. Woe unto you, hypocrites, for ye compass sea and land to make one proselyte; and when he is become so ye make him twofold more a son of hell than yourselves.[1]

[1] "Now it is impossible to persuade an adult savage that his gods do not exist; and he considers those who deny their existence to be

Thus would a mind like Jesus Christ's speak in the latter end of the nineteenth century, if he were here to speak.[1]

Who persecuted the great pioneers of science? the Christian priests—they have always endeavoured to cast out the kingdom of knowledge. They enter not themselves, and would always prevent others from doing so. But the kingdom of knowledge is at hand, for the day is arriving, that "day of days, the great day of the feast of life, is that in which the inward eye opens to the unity in things" (Emerson).

This is the conception of true religion.

ignorant foreigners, unacquainted with the divine constitution of his country. Hence he laughs in his sleeve at all that the missionaries say."—("The Martyrdom of Man," Winwood Reade, 13th Edition, 1890, p. 241.)

[1] "Thus, at last, out of the old conception of our Bible as a collection of oracles—a mass of entangling utterances, fruitful in wrangling interpretations, which have given to the world long and weary ages of 'hatred, malice, and all uncharitableness'; of fetichism, subtlety, and pomp; of tyranny, bloodshed, and solemnly constituted imposture; of everything which the Lord Jesus Christ most abhorred—has been gradually developed through the centuries, by the labours, sacrifices, and even the martyrdom of a long succession of men of God, the conception of it as a sacred literature—a growth only possible under that divine light which the various orbs of science have done so much to bring into the mind and heart and soul of man—a revelation, not of the Fall of Man, but of the Ascent of Man—an exposition, not of temporary dogmas and observances, but of the eternal law of righteousness—the one upward path for individuals and for nations. No longer an oracle, good for the 'lower orders' to accept, but to be quietly sneered at by 'the enlightened'—no longer a fetich, whose defenders must become persecutors, or reconcilers, or 'apologists'; but a most fruitful fact, which religion and science may accept as a source of strength to both."—("The History of the Warfare of Science with Theology in Christendom," A. D. White, 1896, vol. ii. p. 395.)

The priest can plead but one of two pleas. Either he is absolutely ignorant of the present progress of human intelligence, which would seem impossible, and in which case he is not worthy of his position, or else he must plead the most complete deceit and hypocrisy.[1] No real progress can be effected till this deceit is removed, and then morality will take its place.[2]

[1] *Moral*, or *ethical Materialism*, is something quite distinct from scientific materialism, and has nothing whatever in common with the latter. This "actual" materialism proposes no other aim to man in the course of his life than the most refined possible gratification of his senses. It is based on the delusion that purely material enjoyment can alone give satisfaction to man; but as he can find that satisfaction in no one form of sensuous pleasure, he dashes on wearedly from one to another. The profound truth that the real value of life does not lie in material enjoyment, but in moral action—that true happiness does not depend upon external possessions, but only in a virtuous course of life—this is unknown to ethical materialism. We therefore look in vain for such materialism among naturalists and philosophers, whose highest happiness is the intellectual enjoyment of Nature, and whose highest aim is the knowledge of her laws. We find it in the palaces of ecclesiastical princes, and in those hypocrites who, under the outward mask of a pious worship of God, solely aim at hierarchical tyranny over, and material spoliation of, their fellow-men. Blind to the infinite grandeur of the so-called 'raw material,' and the glorious world of phenomena arising from it—insensible to the inexhaustible charms of Nature, and without a knowledge of her laws—they stigmatize all natural science, and the culture arising from it, as sinful 'materialism,' while really it is this which they themselves exhibit in a most objectionable form. Satisfactory proofs of this are furnished, not only by the whole history of the 'infallible' Popes, with their long series of hideous crimes, but also by the history of the morals of orthodoxy in every form of religion." —("The History of Creation," Prof. Ernst Haeckel, 1892, vol. i. p. 37.)

[2] Have we improved in morality? Let us consider the following:

And now, bishop with lawn sleeves and gemmed fingers, when you bury your face within those hands in pious meditation, know that you are acting a lie of the most pernicious character, and one which is producing the greatest amount of human misery. And this conventional lie of our civilization is the basis of the structure of our social, political, and international institutions![1] And this lie is the product

"The elevated moral code of the Todtenbuch is another proof of the great antiquity of Egyptian civilization. Morality is a plant of slow growth which has hardly an existence among rude and primitive tribes, and is only slowly evolved either by contact with superior races or by long ages of settled social order. How many centuries did it take before the crude and ferocious ideas of the Hebrew tribes wandering in the desert or warring with the Canaanites, were transformed into the lofty and humane conceptions of the later prophets, of Hillel and of Jesus! And yet we find all the best maxims of this later morality already existing 5000 years before the Sermon on the Mount, in the Sacred Book of ancient Egypt. The prayer of the soul pleading in the day of judgment before Osiris and the Celestial Jury, which embodies the idea of moral perfection entertained by the contemporaries of Menes, contains the following articles—'I have told no lies; committed no frauds; been good to widows; not overtasked servants; not lazy or negligent; done nothing hateful to the gods; been kind to slaves; promoted no strife; caused no one to weep; committed no murder; stolen no offerings to the dead; made no fraudulent gains; seized no lands wrongfully; not tampered with weights and measures; not taken the milk from sucklings; not molested sacred beasts or birds; not cut off or monopolized water-courses; have sown joy and not sorrow; have given food to the hungry, drink to the thirsty, and clothed the naked: I am pure, I am pure.'"—("Human Origins," S. Laing, 1895, p. 120.)

How many of us, in the nineteenth century, can put our hands to our breasts, bow the head and say, "I am pure, I am pure"?

[1] See Max Nordau's "Conventional Lies of our Civilization."

of university education![1] Until this lie is eradicated, truth[2] cannot be perceived and morality can hardly exist.[3]

[1] "It has to be confessed that in England during the nineteenth century the educated classes, in almost all the great political changes that have been effected, have taken the side of the party afterwards admitted to have been in the wrong,—they have almost invariably opposed at the time the measures they have subsequently come to defend and justify. This is to be noticed alike of measures which have extended education, which have emancipated trade, which have extended the franchise. The educated classes have even, it must be confessed, opposed measures which have tended to secure religious freedom and to abolish slavery. The motive force behind the long list of progressive measures carried during this period has in scarcely any appreciable measure come from the educated classes; it has come almost exclusively from the middle and lower classes, who have in turn acted, not under the stimulus of intellectual motives, but under the influence of their altruistic feelings."—("Social Evolution," Benjamin Kidd, 1895, p. 250.)

[2] "Truth is truth, and fact is fact, and that it is always better to act and to believe in conformity with truth and fact, than to indulge in illusions. There are many things in Nature which jar on our feelings and seem harsh and disagreeable, but yet are hard facts, which we have to recognize and make the best of. Childhood does not pass into manhood without exchanging much that is innocent and attractive for much that is stern and prosaic. Death, with its prodigal waste of immature life, its sudden extinction of mature life in the plenitude of its powers, its heart-rending separations from loved objects, is a most disagreeable fact. But it would not improve matters to keep grown-up lads in nurseries for fear of their meeting with accidents, or becoming hardened by contact with the world. Progress, not happiness, is the law of the world; and to improve himself and others by constant struggles upwards is the true destiny of man."—("Modern Science and Modern Thought," S. Laing, 1896, p. 104.)

[3] "So far from morality being a thing altogether apart from human nature, and which owes its obligation solely to its being a revelation of God's will, it may be truly said in a great many cases

that, as individuals and nations become more sceptical, they become more moral. Thus, for instance, an implicit belief in the inspiration of the Old Testament perverted the moral sense to such an extent that the most monstrous cruelties were inflicted in the name of religion. Murders, adulteries, witchcraft, religious wars and persecutions, all found their origin and excuse in texts either expressly enjoining them, or showing that they formed part of the character and conduct of men 'after Jehovah's own heart.' We no longer burn heretics, torture old women, or hew captives in pieces before the Lord. Why? Because we have become sceptical, and no longer believe in the Bible as an infallible record of God's word. When we find anything in it contrary either to the facts of science or to the moral instincts of the age in which we live, we quietly ignore it; and, instead of trying Science and Morality, as our forefathers did, at the bar of Inspiration, we reverse the process and bring Religion before the bar of Reason.

"Is the world better or worse for this latest phase of its evolution? Is it more or less tolerant, humane, liberal-minded, charitable, than it was in the ages of superstitious faith? The answer is not doubtful, and it confirms my position that, as a matter of fact, as we have become more sceptical we have become more moral."—("Problems of the Future," S. Laing, 1894, p. 206.)

V.

SOCIAL EVOLUTION.

ANYONE who studies the signs of the times, and observes the wonderful physical and mental progress going on, and the political, religious, and social influences, frequently antagonistic to progress, at work, must be struck by this one fact, that we are living in a condition of very active change. The problems to be solved are getting more and more serious, and the tension is getting more and more acute.

It is most certainly no good looking at the past, for there is no precedent in history for the present condition of things. The learned are not in the run, and the world is moving faster than the politicians.

Western civilization is drawing to a crisis. We are entering a new era. We are approaching unprecedented social and political problems. Neither science nor the leaders of mankind venture to indicate to what issue we are tending. The thoughtful are passive. They are looking for the leaders who will point a clear future. Science has hitherto been destructive of old ideas, it must also be constructive of new ideas.[1]

[1] "Yet the social phenomena which are treated of under the heads of politics, history, ethics, economics, and religion must all be regarded as but the intimately related phenomena of the science of life under its most complex aspect. The biologist whose crowning work in the century has been the establishment of order and law in

Man is beginning to learn slowly, very slowly, that he is part of a universal brotherhood.[1] From the thraldom of class influence man is merging. Old institutions must fall, and the religion of the future must be humanitarian, that is to say, that religion which suppresses human misery, and tends to produce human happiness. Commercial progress is cementing nations together in the arts of peace, and this must of necessity continue. The next war (if such a war take place)

the lower branches of his subject has carried us up to human society and there left us without a guide. It is true that at an earlier stage he has been warned off the ground at the other side and treated with bitterness and intolerance. But there is no reason why the remembrance of such treatment should cause him still to so far forget himself and his duty to science, that we should find him in a state of mind capable of speaking of any class of social phenomena as grotesque fungoid growths. In the meantime, each of the departments of knowledge which has dealt with man in society has regarded him almost exclusively from its own standpoint. To the politician he has been the mere opportunist; to the historian he has been the unit which is the sport of blind forces apparently subject to no law; to the exponent of religion he has been the creature of another world; to the political economist he has been little more than the covetous machine. The time has come, it would appear, for a better understanding and for a more radical method; for the social sciences to strengthen themselves by sending their roots deep into the soil underneath from which they spring; and for the biologist to advance over the frontier and carry the methods of his science boldly into human society where he has but to deal with the phenomena of life where he encounters life at last under its highest and most complex aspect."—("Social Evolution," Benjamin Kidd, 1895, p. 29.)

[1] "The better a man understands the true connection of his soul with the souls of his fellow-beings, and the better he comprehends his right relation to the great whole of all-existence, the more will he conform to what he calls the laws of sociology and the moral rules of conduct. And the more he conforms to these conditions, the fitter he will be to survive in the struggle for existence."—("Fundamental Problems," Dr. Paul Carus, 1889, p. 207.)

amongst civilized nations will be so deadly, so crushing and so rapid, and moreover will so utterly disorganize commerce, that it must soon exhaust itself. The dominant or commanding factor in the future must be commerce. The facts tend to the view that war is becoming so terrible that even warriors fear the risk.

International civilized society is tending to become one concrete whole.

While this civilization is progressing—and it largely is the result of division of labour—this great faculty of dividing labour to the utmost is producing a great evil. Often the skilled worker is no longer finding himself the master of his craft. He now has simply to do some small departmental detail—he becomes a part of a huge machine. From the conditions of this system he has to adapt himself to the machinery or throw himself out of employ—a victim of poverty and misery. Progress therefore is adverse to such a class. How little does it benefit by the division of labour! A growing discontent is generating in the bosom of the skilled artisan; he finds as science and commerce divides and sub-divides his position, he becomes more and more a mere tool, always working at the same minute detail. Side by side with this condition of things, with free education, with a free press, he gets a larger expanse of thought, but he finds his class progresses but little. He works sullenly. He sees capital getting into fewer hands, and capital becoming more despotic.[1] It cannot

[1] "We may state it, indeed, as a general law of a society based upon wealth: *that the misery of the labouring classes is directly proportional to the luxury of the wealthy.* This law is a very old one indeed; the only strange thing is that it is every day forgotten."—("Socialism, in Theory and Practice," "From the Ethic of Freethought," Karl Pearson, M.A., 1888, p. 361.)

be expected with the power he now holds that he will be content with the present state of things. Such a condition tends to make society unstable. The operative feels himself regarded as a mere tool, and when its sharp edge has gone he is cast aside as worthless. There is no sympathy. All is reduced to a mere mechanical routine. If there be a fault it is the system that is in fault.

The leaders of science have too often prostrated themselves to the mere object of commercial success. The fundamental question is nearly always, "Will the discovery pay?" They have disclaimed in great part the more noble objects of investigation. To obtain a patent for some material discovery, some new combination, in a word to make wealth out of science is generally the object of scientific investigation. But there are noble exceptions. We speak of the majority. The mental power of man is almost wholly sacrificed to the acquisition of wealth. Buy, buy at the cheapest, sell at the dearest, involves active competition, not of emulation, but of extermination between employers and employed; and of necessity it involves a brutal system of sweating to the weakest, who may be unable to hold their own. The greater the output through new inventions, improved machinery, the more acute the competition, and more over-production must be the result, tending to drive the workers to starvation.

The rivalry between the employers produces a concentration to departmental detail which is destructive to the higher thinking powers. Men exhaust their minds in one department of business, and they are lost to the greater grasp of human affairs; they become the tools of the charlatan the very instant

they merge from that department of life which is the individual's calling.[1] The position is intolerable, and thus with the employer of labour and the professional classes[2] there is an equal tension and anxiety, as

[1] "The ordinary run of men live among phenomena of which they know nothing and care less. They see bodies fall to the earth, they hear sounds, they kindle fires, they see the heavens roll above them, but of the causes and inner working of the whole they are ignorant, and with their ignorance they are content."

"'Understand the structure of a soap-bubble?' said a cultivated literary man whom I know, 'I wouldn't cross the street to know it.'"

"And if this is the prevalent attitude now, what must have been the attitude in ancient times, when mankind was emerging from savagery, and when history seems composed of harassments by wars abroad and revolutions at home?" . . . "The great bulk of mankind must always remain, I suppose, more or less careless of scientific research and scientific result, except in so far as it affects their modes of locomotion, their health and pleasure, or their purse."—("Pioneers of Science," Prof. Oliver Lodge, F.R.S., 1893, pp. 5, 6.)

[2] "Our vital statistics show that the severest stress, the hardest work, and the shortest lives are not so much the lot of the poor as of the business and professional classes. The appetite for success is really never satisfied, and a deeper insight into the conditions of the rivalry reveals that it is necessarily so; it grows with eating but it remains insatiable."—("Social Evolution," Benjamin Kidd, 1895, p. 59.)

"A marked feature, therefore, of all the most advanced and progressive societies is the high pitch at which the rivalry of life is maintained within the community, the freedom of the conditions of this rivalry, and the display of energy and the constant stress and strain which accompany it. Look where he will, the evolutionist finds no cessation of the strenuous conditions which have prevailed from the beginning of life; the tendency, on the contrary, seems to be to render them more severe. Progress continues to be everywhere marked with the same inevitable consequences of failure and exclusion from the highest possibilities of life, for a large proportion of the individuals concerned."—(*Idem*, p. 70.)

is found in the most wretched artisan passing from door to door seeking for the employment he cannot obtain.

But with the views we are now reaching, that is, a knowledge of regeneration, and our adapting ourselves to this fundamental idea, there are given to our political, religious, social, and domestic actions, as also to international actions, new and higher impulses. At the present moment we are doing our best to develop a rickety, a degenerated population at the expense of the waning energies of the healthy.[1] The consequent strain

[1] "The whole history of nations, or what is called 'Universal History,' must therefore be explicable by means of *natural selection*—must be a physico-chemical process, depending upon the interaction of Adaptation and Inheritance in the struggle for life. And this is actually the case. And yet not only natural selection, but artificial selection as well, is variously active in the history of the world.

"A remarkable instance of *artificial* selection in man, on a great scale, is furnished by the ancient Spartans, among whom, in obedience to a special law, all newly-born children were subject to a careful examination and selection. All those that were weak, sickly, or affected with any bodily infirmity, were killed. Only the perfectly healthy and strong children were allowed to live, and they alone afterwards propagated the race. By this means, the Spartan race was not only continually preserved in excellent strength and vigour, but the perfection of their bodies increased with every generation. No doubt the Spartans owed their rare degree of masculine strength and rough heroic valour (for which they are eminent in ancient history) in a great measure to this artificial selection.

"Many tribes also among the Red Indians of North America (who at present are succumbing in the struggle for life to the superior numbers of the white intruders, in spite of a most heroic and courageous resistance) owe their rare degree of bodily strength and warlike bravery to a similar careful selection of the newly-born children. Among them, also, all children that are weak or affected with any infirmity are immediately killed, and only the perfectly strong individuals remain in life, and propagate the race. That the race becomes greatly strengthened, in the course of very many

becomes more and more acute—for we are attempting an impossibility, the result of which is more hospitals—

generations, by this artificial selection cannot in itself be doubted, and is sufficiently proved by many well-known facts.

"The opposite of this artificial selection of the wild Redskins and the ancient Spartans is seen in the individual selection which is practised in modern civilized countries, by the advances of medical science in our day. Although still little able really to cure internal diseases, yet medical men possess and practise more than they used to do the art of prolonging life during lingering, chronic diseases for many years. Such ravaging evils as consumption, scrofula, syphilis, and also many forms of mental disorders, are transmitted by inheritance to a great extent, and transferred by sickly parents to some of their children, or even to the whole of their descendants. Now, the longer the diseased parents, with medical assistance, can drag on their sickly existence, the more numerous are the descendants who will inherit incurable evils, and the greater will be the number of individuals, again, in the succeeding generation, thanks to that artificial '*medical selection*,' who will be infected by their parents with lingering, hereditary disease.

"A more dangerous and injurious form of selection even than medical selection, is that momentous process which we term '*clerical selection*,' and which is practised by all powerful and united hierarchies. In every country where a centralized clerical body has exercised its destructive influence for centuries upon the education of the young, upon family life, and thus upon the principal foundations of the national life, the sad consequences of this demoralizing 'clerical selection' are distinctly evident in the decay of culture and morality. We need only look at Spain, at this 'most Christian' land in Europe! It is most obvious that the highest development of the power of the Roman Catholic Church, during the Middle Ages, coincides with the lowest decline of scientific inquiry and of morality in general." . . .

"In the same way as by a careful rooting out of weeds, light, air, and ground is gained for good and useful plants in like manner, by the indiscriminate destruction of all incorrigible criminals,* not only

* This is a bald statement of fact; it must not be supposed that the author recommends such drastic measures, neither does it appear that Prof. Haeckel does so. Like results can be obtained by more humane methods.

more lunatic asylums—more doctors—more taxes, more oppression—more misery. The efforts of the medical world are all put forth to ameliorate the condition. But science tells us that we live in a complex condition of things, where the germs of all diseases surround us,[1] that we breathe them hourly,

would the struggle for life among the better portion of mankind be made easier, but also an advantageous artificial process of selection would be set in practice, since the possibility of transmitting their injurious qualities by inheritance would be taken from those degenerate outcasts."

"Against the injurious influence of the various kinds of artificial selection, we fortunately have a salutary counterpoise, in the invincible and much more powerful influence of *natural selection*, which prevails everywhere. For in the life of man, as well as in that of animals and plants, this influence is the most important transforming principle, and the strongest lever for progress and amelioration. The result of the struggle for life is that, in the long run, that which is better, because more perfect, conquers that which is weaker and imperfect. In human life, however, this struggle for life will ever become more and more of an intellectual struggle, not a struggle with weapons of murder. The organ which, above all others, in man becomes more perfect by the ennobling influence of natural selection, is the *brain*. The man with the most perfect understanding, not the man with the best revolver, will in the long run be victorious; he will transmit to his descendants the qualities of the brain which assisted him in the victory. Thus then we may justly hope, in spite of all the efforts of retrograde forces, that the progress of mankind towards freedom, and thus to the utmost perfection, will, by the happy influence of natural selection, become more and more a certainty."—("The History of Creation," Prof. Ernst Haeckel, 1892, vol. i. pp. 175-179.)

[1] "Without doubt, the germs which are the authors of these diseases are everywhere scattered around, but attenuated; and in this state a man may carry them about him or in his intestinal canal without great damage. They only become dangerous when, by conditions of overcrowding, and perhaps of successive developments on the surfaces of wounds, in bodies enfeebled by disease, their virulence

and that it is *only the vigorous and strong to whom these various influences are generally harmless.* HENCE THE NECESSITY THAT ALL WHO ARE BORN SHOULD BE PLACED IN SUCH A POSITION AS TO BE DEVELOPED ONLY AS VIGOROUS AND HEALTHY ORGANISMS.

We see the select few fortifying their position of exclusiveness, with generally only one view in life, that is, to maintain their position at the cost of the misery of the masses.[1] Money, to make money, to get position and surround themselves with luxury of every description is their sole aim.[2] Intelligence is the second or no consideration. To dress themselves in the height of fashion, to loll in their carriages, and to be gaped at by a wretched crowd, too often, satisfies

is re-inforced."—("Louis Pasteur, His Life and Labours," 1885, p. 249.)

[1] "A large proportion of the population in the prevailing state of society take part in the rivalry of life only under conditions which absolutely preclude them, whatever their natural merit or ability, from any real chance therein. They come into the world to find the best positions not only already filled, but practically occupied in perpetuity."—("Social Evolution," Benjamin Kidd, 1895, p. 247.)

[2] "If we examine the motives of our daily life, and of the lives of those with whom we come in contact, we shall have to recognise that the first and principal thought in the minds of the vast majority of us is how to hold our own therein. The influence of the rivalry extends even to the innermost recesses of our private lives. In our families, our homes, our pleasures, in the supreme moments of our lives, how to obtain success or to avoid failure for ourselves, or for those nearest to us, is a question of the first importance. Nearly all the best ability which society produces finds employment in this manner. It is no noisy struggle; it is the silent determined striving of vigorous men in earnest, who are trying their powers to the utmost. It leaves its mark everywhere in the world around us. Some of the most striking literature modern civilisation has produced has taken the form of realistic pictures of phases of the struggle which are always with us."—(*Idem*, p. 57.)

them.[1] They hear of human wretchedness in the papers, and it is unpleasant, the papers are folded up and put aside. They often do not want to know of the existence of human misery—or for a pretence, they patronize some bazaar or concert in which the leaders of Vanity Fair must hold the prominent positions, to create a mere pittance to mitigate human suffering, while at the same time they are in great part the factor in breeding disease and misery. And the dole satisfies ignorance. Thus we are manufacturing human misery and breeding as fast as possible a degenerated population. And the maintenance of this population always presses hardest upon that deserving stratum of population, which exists just above the pauper classes. A class which works hard, very hard, to avoid a premature death or falling into that vortex of misery—pauperism. Increased taxation, the concentration of capital, and selling at an unremunerative profit are factors which are destroying this lower middle class.

We have undertaken to give free education to the starving lower orders, while there is every encouragement given for an unlimited development of this

[1] "And it must be remembered that the universal experience of mankind has been, and is still, that wealth and culture divorced from the control of ethical influences of the kind in question have not sought to find satisfaction in what are called the higher altruistic pleasures, but that they have rather, as evolutionary science would have taught us, sought the satisfaction of those instincts which have their roots deepest in our natures. Voluptuousness and epicureanism in all their most refined and unmentionable forms have everywhere been, and everywhere continue to be, the accompaniments of irresponsible wealth and power, the corresponding mental habit being one of cultured contempt for the excluded and envious masses."—("Social Evolution," Benjamin Kidd, 1895, p. 255.)

offspring! Our efforts to do the impossible are killing us. These beings Nature in her grand *rôle* cuts off the earliest. She puts them out of their misery generally before the mental powers have reached a condition to appreciate misery. We, in our egotism, believing Nature to be a fool, are making war on Nature at every step. But Nature calmly looks on and seems to smile at our futile efforts, and when questioned by the earnest student distinctly responds and tells this bitter tale: "GO ON FIGHTING MY GRAND NATURAL LAWS, AND JUST AS YOU FIGHT THEM, SO YOU ADD TO YOUR OWN DISTRESS, PAIN, DISEASE, AND UTTER WRETCHEDNESS, UNTIL YOUR DEPLORABLE CONDITION TEACHES YOU KNOWLEDGE."

What manner of man is there amongst us, who, sowing weeds with his wheat, would complain that the weeds choked the wheat when the plants grew? And this we are doing. We are sowing the diseased, the weak and degenerated amongst the strong. We are nursing the diseased ones and then complain of our miserable existence and find that life is not worth living. The oppression is terrible and is increasing, and this is all because men refuse to look at the natural laws, and the priests lead the van. Society is framed upon one huge lie. It is the religious lie. We live in eternity, we regenerate.[1]

[1] The old idea of the human resurrection cannot for a moment be upheld in view of the facts revealed by science. It supposed that after death the spirit would assume the form of the departed, so that it could be recognized, and thus spirit could see spirit and obtain an eternal reunion of sensations. And this resumption of spiritual form was generally considered to be that of the last phase of life.

Let us consider the following parables: A certain beautiful mother died leaving a young daughter, also very beautiful, and she was

Just in proportion to the increase of class interest—the interest of the privileged classes—does the average probability of regeneration in the world of wretchedness become greater. Who is there amongst us who would elect to be born in many of the wretched conditions of life we find existing in this world? Think of it, your Majesties and your Royal Highnesses. Think of it, Right Reverend Father in God—Bishop of Vanity Fair. Think of it, Right Honourable Earl of so and so. Think of it, noble Admirals. Think of it, Commander-in-Chiefs. Think of it, ye clergy, parasites of an effete system, and know that you without *one exception* were created from the same infinitesimal atom, from the little egg-cell primarily derived probably from the air, subject to the same laws of development, breathing the same air, living and thinking by the same means, by the same molecular regeneration, as the most degenerated, wretched, hopelessly miserable of beings, and that you also are liable to regenerate under such hopeless conditions.

much beloved by the dying mother. The daughter lived to be a decrepit woman. In the resurrection, would not the mother refuse to recognize the spiritual decrepit woman?

And again:

A man married, while he was young, a beautiful woman. She died soon after her marriage. In process of time the man married again, and the second wife died ten years after her marriage. At the death of the second wife the man was in the prime of life. He lived to be old and very infirm, "sans teeth, sans eyes, sans taste, sans everything." Now, in the resurrection, will either of these wives recognize the husband? Would they not both exclaim, "This is not the man we knew in our time?"

And if there is not the visual resurrection, the whole of the fundamental conception falls to the ground; it is impossible, unthinkable.

And why are you as you are? Merely an incident, what appears to our minds as an accident, that you found a host in the parent in the exceptional position of life in which you were born.[1] Is there much to boast about in this accident? And at death you are subject to the same inexorable laws as the most abject beggar. What is your future in the regeneration—in the Eternity before you? Is it your lot to be one of those poor wretches which it is now your principle to put your heel on? Away, we say, away, you must say if you will think, with the condition of human existence which breeds weakness, wretchedness, hopeless unutterable misery. Now, for the first time in the history of mankind, we have a common aim. Let us strive to cultivate it. Nature is helping us. All Nature's efforts are to stamp out, often at the *earliest phase*, the weakest, the least virile, and intellectually the lowest. Civilization is exterminating savage life. The savage regenerates in the new order of things. We do not yet recognize the fact, but it is there. It is

[1] "It is necessary, if we would understand the nature of the problem with which we have to deal, to disabuse our minds of the very prevalent idea that the doctrines of socialism are the heated imaginings of unbalanced brains. They are nothing of the kind; they are the truthful unexaggerated teaching of sober reason. Nor can we stop here. It is evident that *any* organisation of society with a system of rewards according to natural ability can have no ultimate sanction in reason for all the individuals. For the teaching of reason undoubtedly is that as we are all the creatures of inheritance and environment, none of us being responsible for his abilities or for the want of them, so, their welfare in the present existence being just as important to the ungifted as to the gifted, any regulation that the former should fare any worse than the latter must be ultimately, however we may obscure it, a rule of brute force pure and simple."—("Social Evolution," Benjamin Kidd, 1895, p. 82.)

beyond our power to alter the progress of Nature, but we can assist the order of Nature in a humane manner. And this is not done by carrying the lie—the Bible, the rifle, and the gin bottle into the ranks of savage life. We cannot alter the brain-power of savage life, that is, mature life, but we can, often, do a great deal towards altering the brain-power of the growing organism; for this is education, and this can only be obtained in the lower civilized communities, as well as in savage communities, by teaching *the growing organisms*,[1] the

[1] "I believe that with no small proportion of the criminal class the hope of their being reformed is utterly contradicted by experience, and yet the idea of imprisonment for life is repugnant to our feelings, and in many instances would be unjust."—("Some Experiences of a Barrister's Life," Serjeant Ballantine, 1883, p. 339.)

The following is an illustration of this view: "The death has occurred this week in Dartmoor Prison of an old and well-known burglar named David Griffin, who out of the fifty-six years of his life is reported to have spent forty-six in prison. A native of Ireland, he was brought to England by his parents, who, however, were unable to control him, and at the age of nine he was sent to a reformatory. With the aid of three other lads he escaped from here and was not recaptured for four days; and about twenty years ago, when at Dartmoor, he succeeded in escaping, but was quickly recaptured. He had been thirty-four times convicted, four times to penal servitude, and at the time of his death was undergoing a sentence of five years' penal servitude with three years' police supervision. He was known in almost every prison in England and to all the leading Scotland Yard officials, and during the few spans of freedom he was connected with some of the most notorious gangs of country mansion burglars of the last thirty years. He used to boast that when in prison he used to plan his operations for the time when he would be released, and he claimed to be the originator of the mysterious system of silent talking among convicts, which has been the means of many of the daring burglaries being planned among convicts while in gaol."—(From "The Daily Graphic," May 13th, 1897.)

laws by which they are evolved, by which they live, and the laws external to the human being. In a word, to teach man the structure and functions of his own organism, and the relation of that organism to external objects. This is religion. We must regard humanity as a universal brotherhood, as indeed it is, and to encourage each other to produce from our surroundings that condition of things which shall promote the greatest amount of possible health and happiness for *every being which is born*.[1] This undoubtedly we can do. This is altruism, living for a future, higher, *terrestrial* condition of things. But to create disease and misery for the purpose of curing a *few of the sufferers*, for this is our present aim, is illogical and inhuman—but it is Christian—that is in the phase in which we accept Christianity—fashionable Christianity.

What a sad spectacle European civilization presents at the present moment! Europe armed to the teeth.[2]

[1] "We live in a world which is full of misery and ignorance, and the plain duty of each and all of us is to try to make the little corner he can influence somewhat less miserable and somewhat less ignorant than it was before he entered it."—("Lay Sermons, Addresses, and Reviews," Thos. H. Huxley, LL.D., F.R.S., 1893, p. 125.)

[2] "Just cast a glance at this society, and tell us whether it acts from virtuous, divine, or even moral motives? Is it not, in fact, a *bellum omnium contra omnes?* Does it not resemble a race-course, where everyone does all he can to outrun or even to destroy the other? Are we not tempted to say of this society what Burmeister says of the Brazilians: 'Everyone does what he believes he can do without incurring punishment. He cheats and abuses others as much as possible, being convinced that they would do the same to him. Anyone who acts differently is treated as an idiot'? Is it not the most refined egotism which is the spring of this social mechanism; and distinguished authors, who best know human society, do they not

Emperors strutting about like peacocks, their heads decorated with feathers, showing their parts in their reviews of creatures raised, trained, and forced to a business which has the sole object of killing, torturing, and starving their fellow-creatures! War is a game which at the best is a game of hazard. Oh, war! cruel war! which produces misery, pain, and vice of every description; which devastates the frugality of the peasant; which ruins industry; which turns the happiness of peace into a hideous hell.[1] How long

constantly depict in their narrations the cowardice, disloyalty, and hypocrisy of this European society?

"A society which permits human beings to die of starvation on the steps of houses filled with victuals; a society whose force is directed to oppress the weak by the strong, has no right to complain that the natural sciences subvert the foundations of its morality.

"Yes, those who know how to appreciate the ideas we defend, and which are so vehemently attacked by the whole clique of pharisees, hypocrites, mystics, Jesuits, and pietists, may be able to imagine that at some future period there may be a more ideal social edifice, which will have for its foundations human dignity and human equality."—("Force and Matter," Dr. Louis Büchner, 1864, p. 249.)

[1] "The report in the *Times* of the battle of Sedan has the following: 'Let your readers fancy masses of coloured rags glued together with blood and brains, and pinned into strange shapes by fragments of bones. Let them conceive men's bodies without heads, legs without bodies, heaps of human entrails attached to red and blue cloth, and disembowelled corpses in uniform, bodies lying about in all attitudes, and skulls shattered, faces blown off, hips smashed, bones, flesh, and gay clothing all pounded together as if brayed in a mortar, extending for miles, not very thick in any one place, but recurring perpetually for weary hours; and then they cannot, with the most vivid imagination, come up to the sickening reality of that butchery.'

"Inconceivably horrible as were the battle-fields, they were not the only, probably not the worst, of the horrors of war. For one killed in battle, ten or more were killed by slow torture, by wounds, disease,

in the eternity before us will you be the factor in civilization? Is this condition of things to last for ever,

and privation. Add to this the sum of misery of all the widows and orphans of the slain, and then only a few of the most palpable results have been taken into account."—("The Dawn of Civilization," J. C. Spence, 1895, p. 66.)

"The Prussian artillery had raked the French lines through and through before their (the surgeons) eyes; and Dr. Warren confessed to me that, short as was the time they had been on the battle-field, he had seen sights so horrible that the recollection of them would haunt him till his dying day." . . . "I can understand that men find a pleasure in studying the art of fighting, as they do in playing a game of chess; and I have allowed in my own case the fascination which even its horrid reality is capable of exercising over one. But for the man who deems it a pleasure and a glory to use the science of war as a weapon wherewith to annihilate thousands of human beings, for the delusion called 'prestige' or in the game of politics, I would have him to know that it is a foul and monstrous thing, full of hideous suffering, cruelty, and injustice, with nothing to redeem it, save the courage whereby such miseries are endured." . . . "If people at home (and there are some who talk much around their comfortable fires about going to war on every paltry provocation) could have seen the waggon-loads of half-frozen wounded which were brought in to us on the night of the 4th, and those again who lay outside the town without assistance, their wounds uncared for, and exposed to the bitterly cold night air, how soon they would change their idle tone! how they would loathe and abominate the very name of war!" ("With an ambulance during the Franco-German War," C. E. Ryan, F.R.C.S.I., M.R.C.P.I., 1896, pp. 254, 258.)

(A most interesting book; very instructive to those who may wish to realize a FEW of the horrors of war, but the few are sufficient.)

A cautious writer who thoroughly understands his subject concludes his book with the following terrible forecast:—"This tendency towards expansion of British territory in the East is inevitable, however much it may be regretted. To the far East over Burma towards the Mekong River, beyond the Indus from Chitral to British Balúchistán, it has spread, and in the future it must as certainly

or is it that we are willing to regard it as a temporary instrument of the present cultivated savage condition of things, and in a higher civilization to let it speedily become a thing of the past? Look at the inventive power of modern science, and see how much of the human effort is to utilize the forces of Nature for destructive purposes. The forces in Nature are, in a sense, passive. When a discovery of a force in Nature is made, it lies with us to a certain degree whether we utilize that force for good or for evil. And how comes it that these international jealousies, so fruitful of war, exist? The grand factors are: men do not know enough of each other internationally, and

extend till it touches the boundaries of Russian dominion. Before that time comes strange changes will have taken place—changes that must shake to their very foundations the Empires of the West and decide the great question of the future: the contest among the nations of Europe for final supremacy, not only over India but also over the further East—a contest in which the East must inevitably fall vanquished so long as physical force is to decide the pre-eminence of the hardy dwellers in Northern climes over their effete and perhaps more degenerate brethren in the enervating regions of tropical lands.

"At the present moment the whole world throbs to its centre with eagerness to enter on the mighty contest—a contest which all know cannot be long delayed. So portentous appear to be the coming changes that none seems to know whether it were wise to hope that some solution may come speedily or that for a time the West may be allotted opportunity to reconsider her position in the history of the world's civilisation before her irresistible material resources are again sent forth to bend and mould to her ways the sedate and placid peoples whose necks are already bent before their coming conquerors."—("British India," R. W. Frazer, LL.B., 1896, p. 351.)

Much instructive information showing the horrors of war can be obtained in this interesting book.

men are mostly ignorant of the natural laws relating to life. And here comes in the future grand *rôle* of the intelligent artisan. Instead of the workers of each nation trying to oust each other from the means of existence, let them know each other more intimately; the individual struggle for existence will then be felt, and the necessity for the more equal distribution of labour by which they live will be grasped. This can be only done by men more intimately fraternizing. If the money which is spent year by year, if the labour, the sweat of the body, and the anxiety of the mind which is yearly spent to produce instruments of human destruction, and which when used always add slavery to the new-born, if this labour were utilized for the object of international goodwill, with the object of knowing each other, war would soon become impossible. Therefore the functions of progressive civilization are clear and well-marked.[1] And indeed in spite of the

[1] "Biology deals only with living beings as isolated things—treats only of the life of the individual: but there is a higher division of science still, which considers living beings as aggregates—which deals with the relation of living beings one to another—the science which *observes* men—whose *experiments* are made by nations one upon another, in battle-fields—whose *general propositions* are embodied in history, morality, and religion—whose *deductions* lead to our happiness or our misery,—and whose *verifications* so often come too late, and serve only

'To point a moral, or adorn a tale'—

I mean the science of Society or *Sociology*.

"I think it is one of the grandest features of Biology, that it occupies this central position in human knowledge. There is no side of the human mind which physiological study leaves uncultivated. Connected by innumerable ties with abstract science, Physiology is yet in the most intimate relation with humanity; and

opponents to human progress, in spite of the vested interests of the privileged classes which too often live by chaos and misery, this is the progressive tendency of human affairs. The world is being knit into one commercial whole, only we are progressing in the most unsatisfactory, illogical, and clumsy method.[1]

We must mark well there is no precedent for the present condition of things. History cannot help us. Curiously enough, what is termed the educated classes, the classical and orthodox or academical classes, that is, classes which are learned in the past, and which it has been the aim of our great universities to produce,

by teaching us that law and order, and a definite scheme of development, regulate even the strangest and wildest manifestations of individual life, she prepares the student to look for a goal even amidst the erratic wanderings of mankind, and to believe that history offers something more than an entertaining chaos—a journal of a toilsome, tragi-comic march nowhither."—("Lay Sermons, Addresses, and Reviews," T. H. Huxley, LL.D., F.R.S., 1893, p. 75.)

[1] "Man, since we first encounter him, has made ceaseless progress upwards, and this progress continues before our eyes. But it has never been, nor is it now, an equal advance of the whole of the race. Looking back we see that the road by which he has come is strewn with the wrecks of nations, races, and civilisations, that have fallen by the way, pushed aside by the operation of laws which it takes no eye of faith to distinguish at work amongst us at the present time as surely and as effectively as at any past period. Social systems and civilisations resemble individuals in one respect; they are organic growths, apparently possessing definite laws of health and development. Such laws science has already defined for the individual: it should also be her duty to endeavour to define them for society."—("Social Evolution," Benjamin Kidd, 1895, p. 33.)

The student of Social Evolution should study that instructive work "The Martyrdom of Man," Winwood Reade.

are simply nowhere.[1] These men are not now leaders.

[1] "We may well ask, What do our so-called 'educated' circles, who think so much of the high civilization of the nineteenth century, know of these most important biological facts, of these indispensable foundations for understanding their own organization? How much do our speculative philosophers and theologians know about them, who fancy they can arrive at an understanding of the human organism by mere guesswork or divine inspiration? What indeed do the majority of naturalists, even so-called 'zoologists' (including the entomologists!), know about them?

"The answer to this question tells much to the shame of the persons above indicated, and we must confess, willingly or unwillingly, that these invaluable facts of human ontogeny are, even at the present day, utterly unknown to most people, or are in no way valued as they deserve to be. It is in the face of such a condition of things as this that we see clearly upon what a wrong and one-sided road the much-vaunted culture of the nineteenth century still moves. Ignorance and superstition are the foundations upon which most men construct their conception of their own organization, and its relation to the totality of things; and the palpable facts of the history of development, which might throw the light of truth upon them, are wholly ignored.

"The chief cause of this lamentable and mischievous state of things is unquestionably owing to the education given in our higher schools, and, above all, owing to our so-called 'classical education.' For as it is still deeply imbued with the scholasticism of the Middle Ages, it is still unable to digest the enormous advances which natural science has made in our century. It still does not consider that its chief task should be to obtain a comprehensive knowledge of nature—of which we are ourselves a part—or of the present state of the civilized world in which we live; its main object is rather to acquire an accurate knowledge of the history of the ancient countries, and, above all, a knowledge of the Greek and Latin grammars. We grant that a thorough knowledge of classic antiquity is an exceedingly important and indispensable part of our higher education; however, our pleasant acquaintance with antiquity we owe in a much higher degree to painters and sculptors, to epic and dramatic poets, than to classical philologists or to dreaded grammarians. And to enjoy and understand these ancient poets, it is as little necessary for us to read them in the

It is the scientific world and the great commercial classes which are producing this wonderful inter-

original text as it is for us to read the Bible in the original Hebrew. The enormous expense of time and labour demanded by this luxurious sport in classical grammars might be applied to infinitely better purpose, in the study of the wonderful domain of phenomena which have been opened up to us within the last half century by the gigantic advances of natural science, more especially of geology, biology, and anthropology.

"Unfortunately, however, the disparity between our daily increasing knowledge of the real world, and the limited standpoint of our so-called ideal education for the young, is becoming greater day by day. And it is, in fact, those persons who exercise most influence upon our practical education—the theologians and jurists—and likewise the privileged teachers, the philologists and historians, who know least about the most important phenomena of the actually existing world, and of the real history of nature. The structure and origin of our earth, as well as of our own human body—subjects which have become of the utmost interest owing to the astonishing progress of modern geology and anthropology—are unknown to the most of them. To speak of the human egg and its development, they consider either a ridiculous myth or a vulgar piece of immodesty. And yet this subject reveals to us a series of actually recognized facts, which cannot be surpassed in general interest or high importance by any other in the wide domain of human knowledge.

"It is true these facts are not calculated to excite approval among persons who assume a complete distinction between man and the rest of nature, and who will not acknowledge the animal origin of the human race. That origin must be a very unpleasant truth to members of the ruling and privileged castes in those nations among which there exists an hereditary division of social classes, in consequence of false ideas about the laws of inheritance. It is well known that, even in our day, in many civilized countries the idea of hereditary grades of rank goes so far that, for example, the aristocracy imagine themselves to be of a nature totally different from that of ordinary citizens, and nobles who commit a disgraceful offence are punished by being expelled from the caste of nobles, and thrust down among the pariahs of 'vulgar citizens.' What are these nobles to think of the blue blood in their privileged veins, when they learn

national revolution. And whenever a successful commercial man sends his child to these centres of education, as they now exist, he takes the first step towards mental degeneration, for we have seen that the results of much of this education is educated ignorance,[1] hypocrisy, and conventional lies. No, the

that all human embryos, those of nobles as well as commoners, are scarcely distinguishable from the tailed embryos of dogs and other mammals during the first two months of development?"—("The History of Creation," Prof. Ernst Haeckel, 1892, vol. i. pp. 335-337.)

[1] "I weigh my words well when I assert, that the man who should know the true history of the bit of chalk which every carpenter carries about in his breeches-pocket, though ignorant of all other history, is likely, if he will think his knowledge out to its ultimate results, to have a truer, and therefore a better, conception of this wonderful universe, and of man's relation to it, than the most learned student who is deep-read in the records of humanity and ignorant of those of Nature."—("Lay Sermons, Addresses and Reviews," T. H. Huxley, LL.D., F.R.S., 1893, p. 153.)

"It is, however, a most astonishing but incontestable fact, that the history of the evolution of man as yet constitutes no part of general education. Indeed, our so-called 'educated classes' are to this day in total ignorance of the most important circumstances and the most remarkable phenomena which Anthropogeny has brought to light.

In corroboration of this most astounding fact, I will only mention that most 'educated people' do not even know that each human individual is developed from an egg, and that this egg is a simple cell, like that of any animal or plant. They are also ignorant of the fact that, in the development of this egg, an organism is first formed which is entirely different from the fully developed human body, to which it bears no trace of resemblance. The majority of 'educated people' have never seen such a human germ, or embryo, in the early stages of development, nor are they aware that it is not at all different from those of other animals. They do not know that, at a certain period, this embryo has essentially the anatomical structure of a

true university is the world, and true education is the study of Nature and learning to obey, and profit by, the laws of Nature.

No doubt in any arrangement there must be grades in society, there must be a lower order, and an upper order. If such were not the case we should be reduced to a hopeless state of passive mediocrity. Emulation would cease. Competition, so long as it is within the lines of emulation, is healthy, and tends to produce happiness. But this is quite different from the condition of things, which exists at the present moment, when the efforts of men are all tending by honest and *dishonest* means to crush out that individual who seeks to live by honest industry. It is a civil warfare more terrible than actual warfare because it lingers so long. Day by day, through the conditions which must necessarily result from over-population and an increasing over-production, failures—miserable failures in life must go on increasing, and men are forced, in order to live, to become more dishonest. Hence society is getting divided into two classes: the few, that is those who have the power of concentration, especially by division of labour, and often by intrigue, deception, and the grossest of dishonesty—but often legal dishonesty—become exorbitantly rich, and the in-

Lancelet, later of a Fish, and in subsequent stages those of Amphibian and Mammal forms ; and that in the further evolution of these mammal forms those first appear which stand lowest in the series, namely, forms allied to the Beaked Animals ; . . . then those allied to Pouched Animals, . . . which are followed by forms most resembling Apes ; till at last the peculiar human form is produced as the final result."—("The Evolution of Man," Professor Ernst Haeckel, 1883, vol. i. p. 2.)

creasing mass, their slaves, become the miserable poor,[1]

[1] "When we reach the heart of the matter we find it to be, according to Marx, a system by which the capitalist is enabled to appropriate the *surplus value* of the work of the labourers, these being able to retain as wages only what represents the average subsistence necessary for themselves and their children in keeping up this supply of labour. There is thus an inherent antagonism between the two classes.

"As the conflict takes shape it begins to develop remarkable features. At the one pole we have the continued appropriation and accumulation of surplus value, with the ever-increasing wealth and power of those in whose hands it is concentrated. At the other end we have the progressive enslavement and degradation of the exploited classes. As the development continues, the workers, on the one hand, gradually come to recognise their position as a class and become possessed of a sense of their common interests. On the other hand, the competition amongst the capitalist class is great and continually growing; the larger capitalists gradually extinguish the smaller ones, and wealth becomes accumulated in fewer and fewer hands. To quote Marx's words:—'Along with the constantly diminishing number of the magnates of capital, who usurp and monopolise all advantages of this process of transformation, grow the mass of misery, oppression, slavery, degradation, exploitation; but with this, too, grows the revolt of the working class, a class always increasing in numbers and disciplined, united, organised by the very mechanism of the process of capitalist production itself. The monopoly of capital becomes a fetter upon the mode of production, which has sprung up and flourished along with and under it. Centralisation of the means of production and socialisation of labour, at last, reach a point when they become incompatible with their capitalist integument. This integument is burst asunder. The knell of capitalist private property sounds.'* That is to say, the state of things becomes at length intolerable; there is anarchy in production, accompanied by constantly recurring commercial crises; and the incapacity of the capitalist classes to manage the productive forces being manifest, public opinion at last comes to a head. The organized workers seize possession of

* "Capital," Karl Marx, English translation (Swan Sonnenschein & Co., 1887), vol. ii. pp. 788, 789.

creatures born without hope in the whirligig of life.[1]

the means of production, transforming them into public property, and socialistic production becomes henceforward possible."—("Social Evolution," Benjamin Kidd, 1895, p. 226.)

[1] "By the combination of the capitalist classes into rings, trusts, syndicates, and like associations for the universal control of production and the artificial keeping up of prices, the community finds the general welfare threatened by a complication which the reformers of the past can scarcely be said to have counted upon. We have also great organisations and combinations of labour against these capitalist classes whereby the life of the community is disturbed and disorganised to a serious extent, and to which it seems to be increasingly difficult to apply the old doctrine of the restricted nature of the duty of the state. It is evident, moreover, that in these recurring struggles the combatants, if left to themselves, are often unequally matched; for the weapon on one side is merely the power to reduce profits, while on the other it is the right to impose actual want and hunger on large numbers of our fellow-creatures. We have, therefore, public opinion tending more and more to side with the inherently weaker cause, and, under the stimulus of the altruistic feelings, coming to propose measures that leave the *laissez-faire* doctrine of the past far behind."—("Social Evolution," Benjamin Kidd, 1895, p. 216.)

"Another feature of the times which we may notice is that, under the outward appearance of action, the great political party which has carried progress so far in England stands in reality doubting and confused in mind. It moves, it is true, but rather because it is thrust forward; the enthusiasm, the robust faith, the clearly defined conviction that marked its advance through the early and middle decades of the nineteenth century seem to be wanting. The ranks move; but irresolutely. They still appear to wait for the vibrant call of a leader upon whom a larger faith has descended."—(*Idem*, p. 217.)

"We have come to believe that the feudal system is defunct. But the real fact, as Marx realised more clearly than the older economists, is, that the dead hand of feudalism still presses with crushing weight upon the people through almost all the forms and institutions of present-day society. A large part of the existing unregulated and

Such is the present drama of life; and we are all compelled to take a part in this drama.

Now Nature is so prolific in her resources that the raw material seems to exist without a power of exhaustion. As we keep on dividing and sub-dividing by division of labour, the greater and greater are the quantities of manufactured commodities produced, until we are reduced to a position of absolutely giving away the products of labour. This is illustrated by the new institutions—free libraries. Do these institutions do good? If education fundamentally consists in teaching man his own constitution, the relation of

uncontrolled rights of wealth and capital are in reality merely the surviving rights of feudalism adapted to new conditions."—(*Idem*, p. 246.)

"A word of admonition, if not of advice, might even be profitable to rulers, statesmen, and legislators in these days. The socialist and nihilist movement all over Europe, from Russia to Spain, the simultaneous attempts on the lives of most of the Continental sovereigns, as the recognized key-stone of the social fabric, are surely symptoms of some deep-rooted disease, of something seriously wrong in our present social system, which is well worthy the attentive consideration of statesmen as well as of thinkers; and something for the cure of which neither more stringent repression nor aggressive foreign wars, the favourite treatment hitherto adopted, will suffice in future. The root cause of the socialistic movement is in reality the poverty of the many in our modern rich communities, joined to a rankling sense of injustice, neither of which, difficult as they may be and are of cure, are to be removed by internal repression or foreign aggression; but, if by anything, by internal reform in institutions, and by the removal of social injustices which still everywhere exist, notwithstanding the reforming spirit that has been active for a long time in their partial removal. For justice may be reached on the Earth, even though fraternity and social equality be only possible in the Happy Republic of the philosophers."—("The Creed of Science," William Graham, M.A., 1884, p. 287.)

that constitution to external things, and the necessity of adaption to the Natural laws, it is questionable whether free libraries help much in this direction. A sensational and often morbid novel does little towards education. It is even a question if it is not antagonistic to education. Is not such literature the chief demand in our public and other libraries? What does civilization think of the literature of the bookstall at a railway station?

No, this is not the direction of progress, in a small way it may help. What is required is to destroy the altars in our religious institutions, and substitute the screen, and by means now at hand on that screen to picture every phase of human life, and every phenomenon in Nature, to teach each and all how much the human being is the creature of circumstances, that is of his surroundings, and above all to teach forbearance for our less fortunate brethren, and thus teach us how to extract the greatest amount of human happiness, not only for ourselves, but for others—not only for our nation, but for all nations. This should be the function of the priests. It must come, it is ordered by a power stronger than human power.[1] Would it not

[1] "Christianity must be destroyed. The civilised world has outgrown that religion, and is now in the condition of the Roman Empire in the pagan days. A cold-hearted infidelity above, a sordid superstition below, a school of Plutarchs who endeavour to reconcile the fables of a barbarous people with the facts of science and the lofty conceptions of philosophy; a multitude of augurs who sometimes smile when they meet, but who more often feel inclined to sigh, for they are mostly serious and worthy men. Entering the Church in their youth, before their minds were formed, they discover too late what it is that they adore, and since they cannot tell the truth, and let their wives and children starve, they are forced to lead

be wiser for the clergy to take the initiative?[1] *It is the duty of every man to help the clergy to do so.*[2] Or will the clergy remain stubborn and resist mental progress until the superior mental power

a life which is a lie. What a state of society is this in which *free-thinker* is a term of abuse, and in which doubt is regarded as a sin. Men have a Bluebeard's chamber in their minds which they dare not open; they have a faith which they dare not examine lest they should be forced to cast it from them in contempt. Worship is a conventionality, churches are bonnet shows, places of assignation, shabby-genteel salons where the parochial At Home is given, and respectable tradesmen exhibit their daughters in the wooden stalls. O wondrous, awful, and divine Religion! You elevate our hearts from the cares of common life, you transport us into the unseen world, you bear us upwards to that sublime temple of the skies where dwells the Veiled God, whom mortal eye can never view, whom mortal mind can never comprehend. How art thou fallen! How art thou degraded! But it will be only for a time. We are now in the dreary desert which separates two ages of Belief. A new era is at hand."—("The Martyrdom of Man," Winwood Reade, 1890, p. 541.)

[1] Mr. Kidd says they will do it. Let us hope he is right. He states:—

"*The great process is proceeding as a natural and orderly development*—we are adapting the old institutions to the new wants. This is the real secret of that political genius the Anglo-Saxon peoples are now displaying, and there is scarcely any other quality which promises to stand them in such good stead in that great social revolution with which the history of the twentieth century will be filled."—("Social Evolution," Benjamin Kidd, 1895, p. 324.)

[2] The fundamental text of the priests in the near future must be: to learn and to teach "the lesson of a large toleration and of charity in thought and deed, towards those who, from inherited constitution or unfortunate conditions of education and outward circumstances, fall under the sway of the principle of evil, and lead bad, useless, and unlovely lives. Had you and I, reader, been in their place, should we have done better?"—("A Modern Zoroastrian," S. Laing, 1895, p. 196.)

arising in the masses is forced to expel these obstructionists, to cast them into outer darkness and for ever?

The Sabbath was made for man, and not man for the Sabbath. A time is near at hand when our museums, our art galleries, our cathedrals, churches and chapels will be open on the Sabbath for intellectual development and elevating music set to healthy words, and if the priests will not foster this progress, others must take their place.

Yes, it is a marvellous change we are going through. "Only one hundred years ago, nations and communities were as distant from each other in time as they were at the Christian era. Since then the ends of the world have been drawn together, and civilised society is becoming one vast highly organised and interdependent whole—the wants and requirements of every part regulated by economic laws bewildering in their intricacy—with a nervous system of five million miles of telegraph wire, and an arterial system of railways and ocean steamships, along which the currents of trade and population flow with a rapidity and regularity previously unimagined. The old bonds of society have been loosened; old forces are becoming extinct; whole classes have been swept away, and new classes have arisen. The great army of industrial workers throughout the world is almost entirely a growth of the past hundred years. Vast displacements of population have taken place, and are still taking place. The expansion of the towns, one of the most remarkable features of the industrial revolution, still continues unabated, no less in America and Australia than in England, Germany, and France; and civilisation is everywhere massing

together, within limited areas, large populations extremely sensitive to innumerable social stimuli which did not exist at the beginning of the century. The air is full of new battle cries, of the sound of the gathering and marshalling of new forces, and the reorganisation of old ones. Socialism seems to many minds to have been born again, and to be entering on the positive and practical stage. It has ceased to be a theory, it has begun to be a kind of religion."[1]

Now the key to the great problem is this. We cannot have a high and healthy socialism with a system which tends to an infinite development of population, and especially an infinite development of degenerated population.[2] We have seen that to the powers of procreation there is no limit, and that in the natural order of things Nature stamps out the weakest—Nature murders her offspring. So long, therefore, as we elect to encourage the development of weaklings, so long must we encourage human misery. These unhappy creatures must be maintained at the expense of the labour of the healthy. We must look upon human life with new views. We must bring our ideas in harmony

[1] "Social Evolution," Benjamin Kidd, 1895, p. 7.

[2] "Increase of population in a limited area means increased difficulty of finding employment; and the complex relations of international commerce send panics and crises vibrating throughout the world, which throw millions out of work, or reduce them to starvation wages. . . .

"If we turn to the moral aspects of the question, it is still more clear that evolution does not tend solely to the side of virtue. There is doubtless less ferocious savagery, less rude and unconscious or half-conscious crime, in civilised societies, but there is far more deliberate and diabolical wickedness."—("A Modern Zoroastrian," S. Laing, 1895, p. 176.)

with the natural laws, and instead of labouring to our utmost to create misery, and to work to support misery, we must find a method of preventing the development of misery, of disease, and of crime. And then time is left to enjoy life. It would appear this can be only obtained by the higher order of socialism. Not a dragging down to a lower level, but a raising up to a higher mean level. With the new view of regeneration of life, how important is the issue to *every one of us*.[1]

The system of *laissez-faire*, which may be interpreted: every one for himself, and the devil take the hindmost, cannot be the dominant order of action as it is at present. The higher order of thought means: live for others as well as for

[1] "If we ask ourselves, therefore, what course it is the interest of the masses holding political power in our advanced societies to pursue from the standpoint of reason, it seems hardly possible to escape the conclusion that they should in self-interest put an immediate end to existing social conditions. Man in these societies has placed an impassable barrier between him and the brutes, and even between him and his less developed fellow-creatures. He no longer fears the rivalry or competition of either. The interest of the masses in such societies appears, therefore, clearly to be to draw a ring fence round their borders; to abolish competition within the community; to suspend the onerous rivalry of individuals which presses so severely on all; to organise, on socialistic principles, the means of production; and lastly, and above all, to regulate the population, so as to keep it always proportional to the means of comfortable existence for all. In a word, to put an end to those conditions which the evolutionist perceives to be inevitably and necessarily associated with progress now, and to have been so associated with it, not only from the beginning of human society, but from the beginning of life."—("Social Evolution," Benjamin Kidd, 1895, p. 80.)

oneself. This is true socialism.[1] This is religion, or to use the fashionable term—this is altruism. The study of ourselves and of natural phenomena, and this is the highest study, tends to this order of thought.

The development of organisms is always uncertain. Clever parents seldom have clever children. The want of ability in the child is always beyond his control. We now know this defect arises from a defective organism—the brain, that is, a brain not so highly organized as the parent or parents. And while we must allow such to take a back seat in the condition of things, we should in all cases permit the existence of such beings to be that of as much happiness as their condition may permit. We cannot be all geniuses, but the genius can live to promote happiness for others.

The theoretical conception that all men are born equal is absurd. Men are not born physically equal, and therefore not mentally equal, but this is no reason why those who enjoy the superior advantages of life, should not consider their weaker brethren. Moreover these exceptional minds should always remember what they owe to others, for, "even the ablest men amongst us, whose names go down to history connected with great discoveries and inventions, have each in

[1] "True socialism has always one definite object in view, up to which all its proposals directly or indirectly lead. This is the final suspension of that personal struggle for existence which has been waged, not only from the beginning of society, but, in one form or another, from the beginning of life."—("Social Evolution," Benjamin Kidd, 1895, p. 220.)

reality advanced the sum of knowledge by a comparatively small addition." [1]

In the new condition of things, a condition which is being forced upon us by the march of events, the now emancipated lower classes must play a grand part. But they must educate themselves. They must not follow the mistakes of the so-called higher classes. The history of these classes has been essentially a feudal system, a system of mere brute force. The objects of their lives have been to put their feet on the necks of the lower orders, grind down and enslave them. That example must not be followed by the intelligent working classes. All labour should be a form of co-operation. Employer and employed should have one common object in view, and although this may not be readily seen yet it will be found a fact. To the employer of labour, within certain small limits, it is perfectly immaterial what price is paid for labour—the consumer always has to pay that price. When the operative uses force, that is, strikes for higher wages, one of two results always happens. With a free competition between employers profits are reduced to an absolute minimum, if foreign competition will produce the commodity cheaper than it can be produced at the higher rate of wages—the trade leaves the country, and both employer and employed suffer or are destroyed. Whereas if the higher wage is obtained, the commodities become higher in price, and the consumer has to pay more. Who are the great consumers? Why the working classes. Every strike is not so much a rebellion of the working

[1] "Social Evolution," Benjamin Kidd, 1895, p. 286.

classes against employers of labour, but in the main, a rebellion against their fellow-labourers. There is something very obscure and little understood in the question of currency in relation to commodities, for this is always the issue. It is questionable if the economics of the trade union is the true remedy. Get more money and give less in return is the cry. Moreover the operative should in part look backward and compare his estate with the conditions of his predecessors. Kings and queens a short time ago would have paid large sums to be in possession of a watch an average working man carries about, and which now only costs a few shillings. Many other things are in this proportion in relation to the past.[1] It would seem that the raising of the lower orders must be effected by other means than striking for higher wages. Will it not be by creating a demand for more healthy external conditions for the lower classes?[2]

[1] "As for luxury, a small tradesman at the present day is more luxurious than a king in ancient times. It has been wisely and wittily remarked that Augustus Cæsar had neither glass panes to his windows, nor a shirt to his back; and, without exaggeration, the luxury of the Roman senators may be compared with that of the West Indian Creoles in the last century."—("The Martyrdom of Man," Winwood Reade, 1890, p. 31.)

[2] "Our most earnest philanthropists and zealous workers in the fields of sin and misery in crowded cities are coming, more and more every day, to the conviction that an improvement in the physical conditions of life is the first indispensable condition of moral and religious progress. More air, more light, better lodging, better food, more innocent and healthy recreation, are what are wanted to make any real impression on the masses who have either been born and bred in an evil environment, or have fallen out of the ranks and are the waifs and stragglers left behind in the rapid progress and intense competition of modern society."—("A Modern Zoroastrian," S. Laing,

In the division of labour, no consumer should object to pay such a price as will permit the producer to live in comfort, contentment, and happiness. But to put the matter upon a permanent basis, with the enormous complexities existing, is a work which must engage the best minds. It is a practical matter which will come, and only come, when man sees his true position in the universe, and knows that his prosperity and happiness are subordinate to the natural laws, for they are the laws of that sum of natural powers—THE OMNIPOTENT.

There are those who think that the forces of Nature are blind, and that there is no design in Nature. This is probably a great fundamental error. Anyone who sees the processes Nature adopts, and the gradual perfecting of the Human being, which has been effected by such misery, that it is impossible for any individual to grasp the mental and physical suffering man has passed through[1]—anyone, we repeat, who considers the phenomena now going on can but come to one conclusion: it is an orderly march in Nature towards

1895, p. 224.) If millionaires were to leave their fortunes for pulling down the miserable dwellings of the poor and erecting healthy dwellings, so that human beings could only be developed under healthy conditions, what monuments of greatness would they erect! Is it not better than leaving their wealth for their relations to spend on women, wine and dissipation—their physical and moral ruin?

[1] The student who would wish to partially grasp these sufferings of the past cannot do better than read that most interesting work, "The Martyrdom of Man," by Winwood Reade (Kegan Paul, Trench, Trübner & Co.), and a little-known but most valuable work, "The Law of Civilization and Decay," by Brooks Adams (Swan Sonnenschein & Co.). The latter work shows the causes of much suffering, especially in relation to that great factor in human happiness or misery, the currency.

the perfecting of the most complex and most intelligent of all organisms—Man.[1]

The mind of man is developing; it is getting into a higher and higher condition, and there can be no doubt that the higher we ascend the larger will be our consideration for the welfare and estate of *all*. This is altruism—this is religion.[2]

Looking backward, we find two great factors in human development—"Fear, and Greed. Fear, which,

[1] "It seems likely, when the application of the principles of evolutionary science to history comes to be fully understood, that we shall have to witness almost as great a revolution in those departments of knowledge which deal with man in society as we have already seen taking place in the entire realm of the lower organic sciences through the development and general application, during the latter half of the nineteenth century, of the biological theories enunciated by Darwin. It is evident that we are approaching a period when we shall no longer have the same justification, as in the past, for regarding human history as a bewildering exception to the reign of universal law—a kind of solitary and mysterious island in the midst of the cosmos given over to a strife of forces without clue or meaning. Despite the complexity of the problems encountered in history, we seem to have everywhere presented to us systematic development underlying apparent confusion. In all the phases and incidents of our social annals we are apparently regarding only the intimately related phenomena of a single, vast, orderly process of evolution."—("Social Evolution," Benjamin Kidd, p. 310.)

[2] "For we see that it is possible to interpret the ideals of ethical progress, through love and sociality, co-operation and sacrifice, not as mere utopias contradicted by experience, but as the highest expressions of the central evolutionary process of the natural world. The ideal of evolution is indeed an Eden; and although competition can never be wholly eliminated, and progress must thus approach without ever completely reaching its ideal, it is much for our pure natural history to recognise that 'creation's final law' is not struggle but love."—("The Evolution of Sex," Prof. P. Geddes and J. A. Thomson, 1889, p. 312.)

by stimulating the imagination, creates a belief in an invisible world, and ultimately develops a priesthood; and Greed, which dissipates energy in war and trade." . . . "As consolidation advances, fear yields to greed, and the economic organism tends to supersede the emotional and martial." [1]

As departmental consolidation progresses so does the tyranny of greed become greater. Probably no more dreadful form of this tyranny has ever exceeded the present economical phase of things.

Mr. Adams fully explains this in his chapter on Modern Centralization. He states: "In discussing the phenomena of the highly centralized society in which he lived, Mill defined capital 'as the accumulated stock of human labour.' In other words, capital may be considered as stored energy; but most of this energy flows in fixed channels; money alone is capable of being transmuted immediately into any form of activity." [2]

"It appears to be a natural law that when social development has reached a certain stage, and capital has accumulated sufficiently, the class which has had the capacity to absorb it shall try to enhance the value of their property by legislation. This is done most easily by reducing the quantity of the currency, which is a legal tender for the payment of debts. A currency obviously gains in power as it shrinks in volume." [3]

Now, it is the aim of bankers, who live by lending, to have money scarce, and thus the more the debtors are enslaved. In 1873, or thereabouts, money was

[1] "The Law of Civilization and Decay," Brooks Adams, 1895, Preface.

[2] *Idem*, p. 259.

[3] *Idem*, p. 21.

about one-half thrown out of circulation by the demonetization of silver.

This making money scarce has no doubt been a great advantage to the money-lending class, but it has had the effect of enslaving, degrading, and ruining masses of the producing classes—a most important illustration of the want of feeling and principle in the ever-growing and too powerful capitalist class. Mr. Adams continues:—

"These bankers conceived a policy unrivalled in brilliancy, which made them masters of all commerce, industry, and trade. They engrossed the gold of the world, and then, by legislation, made it the sole measure of values. What Samuel Lloyd and his followers did to England in 1847, became possible for his successors to do to all the gold standard nations after 1873. When the mints had been closed to silver, the currency being inelastic, the value of money could be manipulated like that of any article limited in quantity, and thus the human race became the subjects of the new aristocracy which represented the stored energy of mankind."[1]

Such an act by a department in civilization cannot be right; it is cruel, inhuman—but it is Christian, that is, in harmony with fashionable Christian ideas!

. . . . . .

We live in a beautiful world. The human mind is absolutely not able to conceive anything which is more beautiful than surrounds us, for whenever we attempt to conceive anything beyond this beauty we are deluded by some mental monstrosity which has no reality in Nature. Therefore, what we have to do is to so regulate

[1] *Idem*, p. 289.

our conduct as to make it possible for *all* to enter into the enjoyment of the blessings which surround us, and although we may not succeed in doing this as completely as we might wish, yet there can be no question, much can be done, and in the unknown future no one can conceive how far human efforts can succeed directly the will is exercised in order to obtain the result.

We live in Eternity, we regenerate in Eternity. It is not, therefore, altogether the present we have to look to, but also *our* future. And we can only safely proceed in the direction of future happiness by forwarding the practical result of

PEACE AND GOODWILL TO ALL MEN.

APPENDIX

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THE issue we have raised is so important that we here simplify and more completely illustrate it.

Example:—Everyone must have noticed the heaps of stones lying on the roadside to be used for repairing the road.

These stones are collected, and one by one, "*added*" to the heap. This process is called "*addition.*" We notice that addition is only removing matter from one part of the earth's surface to another part. We cannot create matter. Then when the stones are removed from the heap for the purpose of repairing the road, we take from the heap, and that is "*subtraction.*" These are the only two operations nature recognizes, and therefore are the only two that can be performed by man.

Now, the physicist states such operations are too vague to give absolutely rigid definite ideas. Numerical values must be given to the operations—so far, good. He therefore gathers the stones into say a 5 gallon measure, and *adding* measureful to measureful, say ten *times*, he obtains a heap of stones which has a volume of 50 gallons. This is multiplication (5×10).

Having obtained this heap by "addition," he by "subtraction" takes away half the heap, that is, he fills the measure five times and gets a second heap of

25 gallons. Thus he has two heaps of 25 gallons each. So far he is quite in harmony with the possible, and figures correspond with facts.

But then the mathematical physicist goes a step further. He says: I can multiply the 25 gallon heap by the 25 gallon heap—or multiply the two heaps together. He thus argues that he can obtain a "*numerical value*" of 625 (i.e. 25×25). Now what does this numerical value mean? It cannot be 625 gallons, for he has only 50 gallons, and this he has proved by addition and subtraction. Here comes the fundamental metaphysical error, and it is this error which clouds all natural phenomena.

One asks oneself, how is it that the physicist obtains such remarkable results by his mathematical processes? It is because in the system of pure mathematics the "product" of multiplication is proportional to the "sum" in addition. The following explains this:—

Addition.	*Multiplication.*
$4 + 4 = 8$	$4 \times 4 = 16$
$4 + 5 = 9$	$4 \times 5 = 20$
$4 + 6 = 10$	$4 \times 6 = 24$
$4 + 7 = 11$	$4 \times 7 = 28$

and so on; thus in the above case the steps in addition are by units, while the steps in multiplication are by fours. Now the first operation (addition) in concrete numbers can be performed, while the second (multiplication) cannot be performed—the conception is purely metaphysical.

It is this dwelling upon the impossible, which prevents the physicist grasping the existence of this subtile fluid Ether and its operations *through* and *on* the atom or molecule.

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SINCE the first edition of this book has been published, Prof. Dewar, in a series of three lectures at the Royal Institution of Great Britain,[1] has made most instructive, and fundamental experiments, by means of liquid air, which may be taken as illustrating the conception given in the formula fig. 5, p. 55. We propose in this Appendix to explain these experiments by means of this formula.

First we must premise the constitution of the atmosphere.

Air in the main consists of two classes of gaseous molecules,[2] Nitrogen and Oxygen molecules. Roughly speaking, there are about four times the number of Nitrogen molecules to Oxygen molecules. Other atomic and molecular matter exist; but they are, in volume, not of sufficient importance to notice here.

According to our view, this envelope of air which surrounds the world consists of free molecules, which increase in dimensions (*i.e.* temperature) the higher we rise from the surface of the earth.

The following conveys the conception, where *a* in the diagram, fig. 1, represents the ultimate dimensions of the molecule, holding the greatest quantity of Ether, and *b*, a smaller molecule, holding a less quantity of Ether. *a*, therefore, is of greater

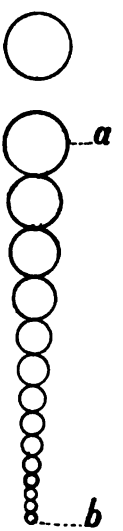

Fig. 1.

[1] Jan. 20th, 27th, and Feb. 3rd, 1898.

[2] It is not quite certain if the gaseous units of which the air consists are atoms or molecules. In order to convey our idea simply we will assume them to be molecules.

temperature (dimensions) than *b*, which is taken to be of the average temperature of the gaseous molecules immediately surrounding the surface of the solid and liquid parts of the world—the habitat of man.

The cause of the decrease of volume of the latter is the pressure of the molecules lying above them—the pressure being in all directions, makes the molecular volume approximately uniform.

Now, if we take air on the surface of the earth, and remove this superincumbent pressure—and this we can do by the exhausting air-pump—we can cause the molecules to swell until they become of the maximum dimensions (*a*). As they become larger or of greater temperature they absorb Ether, and a current of Ether flows *to them*. Conversely, if we take air molecules on the surface of the earth or of the dimensions of *b*, and press them together, as we can by means of a condensing pump, the molecules become smaller in volume (*i.e.* temperature) and we press Ether out of them, and a current of Ether flows *from them*.

It follows, from this view of our atmosphere, that the upper layers consist of molecules of the maximum dimensions moving with little restraint and in the freest manner.[1]

If we could get out of the atmosphere and look upon it as we can look upon the surface of the ocean, we would, probably, be astounded at the vast waves and the great molecular motion existing on the surface of

[1] This explains the reactions found in the radiometer. It is the freedom of action of the air molecules in the apparatus which moves the vanes. The vacuum must not be perfect or nearly perfect; for if this were the case, no molecules, or not a sufficient number would exist in the apparatus to move the vanes.

the atmosphere; and it is most likely that these molecules are so sensitive to external forces that the slightest reaction from the sun operates upon them, producing the depressions and the atmospheric alterations man finds in the lower regions of the air.

We have now our factors. Let us consider two gaseous molecules, in contact, of like dimensions, as illustrated below (fig. 2). And we want to liquefy *b*. We *very quickly* remove pressure from *a*; it seizes Ether from *b*; *a* becomes higher in temperature, *b* lower in temperature (fig. 3). It would appear, however, that this must be done *quickly*, other-

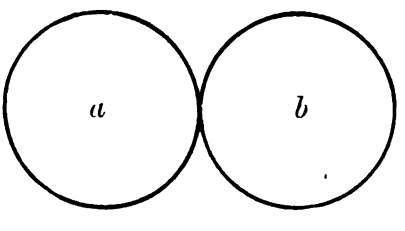

Fig. 2.

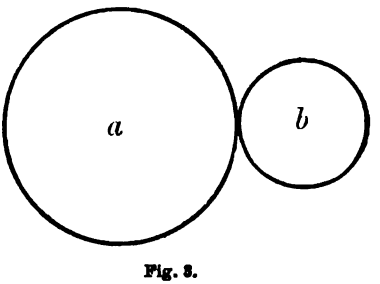

Fig. 3.

wise, as *a* increases in temperature, *b* picks up Ether as fast, or nearly as fast, as it parts Ether to *a*. In this case there is no decrease of temperature in *b*; it remains constant in temperature, or nearly so.

Now, if we assist this reaction by putting pressure upon *b* *at the same time* as we are removing pressure from *a*, *b* will be so reduced in volume (*i.e.* temperature) that it will become of the dimensions of a liquid molecule. This is only seen in a mass of molecules.

This illustration explains the principle involved. Of course we cannot do this with two molecules, but we

can perform the operation with a mass of molecules—a given volume of air. All we have to do is to put air in a closed cylinder, compress it by means of a piston and at the same time place the cylinder in a second cylinder containing a material whose atoms or molecules are *quickly* expanding and absorbing Ether when pressure is removed, and this we can do by pressing gases into a very small space and then letting them expand, or by means of the exhaust pump. The material Prof. Dewar finds most suitable is carbon di-oxide. This only explains the principle—the apparatus used by Prof. Dewar to obtain gases in the liquid condition involves many and complex structural conditions.[1]

The product of these two operations is liquid air. "A very faint blue" liquid.

The molecules of the liquid are, however, in an abnormal condition; they want of *their own inherent power* to again absorb Ether to become gaseous—which is their normal condition.

To restrain this reaction was one of Prof. Dewar's most difficult problems. He devised a double receiver having an absolute vacuum (as far as gases are concerned) between the two glass receivers.

Fig. 4 illustrates the form of the vessel, where the inner vessel is kept away from the outer by an absolutely empty space or a vacuum. Prof. Dewar finds covering the outside of the inner receiver with a thin layer of silver makes the vessel more impervious to the passage of Ether. Filling the space between the receivers with mercury in the gaseous condition, and a small excess of liquid mercury at the bottom, as illus-

[1] See Proceedings Royal Institution of Great Britain, vol. xv. No. 90, 1896, p. 144.

trated, answers nearly as well. The gaseous mercury condenses by the intense cold of the liquid air on the outside of the inner receiver and up to the height of the liquid gas. This absolute vacuum (as regards gases) nearly prevents the passage of Ether to the liquid air, and thus the air retains its liquid condition or only

Fig. 4.

evaporates, *i.e.* becomes gaseous very slowly indeed; probably the small amount of Ether obtained by the liquid is received *viâ* the glass, and not *viâ* the vacuum. Liquid air, subject only to the pressure of the atmosphere, can be kept, in such a receiver, for days.

Now if we pour this liquid air into an open vessel, say a saucer, what takes place? Each molecule, of its own *inherent energy*, becomes gaseous, seizes the Ether from the surrounding atmosphere while it is increasing in volume, and cools it, and especially the saucer, which becomes so intensely cold that the water vapour in the atmosphere condenses on the outside in the form of ice.

If liquid air, in such a vacuum receiver, be evaporated *very quickly*, by means of the exhaust pump, the upper layers of the liquid seize Ether so fast from the lower layers, that the latter become solid, *i.e.* "a stiff transparent jelly"[1] (temp., −216° C.), or even "a clear transparent, solid ice."[2]

Prof. Dewar illustrates the reaction of liquid air on gases by some very remarkable and instructive fundamental experiments. He fills glass receivers, illustrated in section figs. 5 and 6, of a capacity of

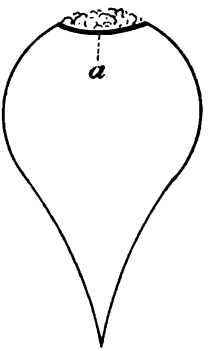

Fig. 5.

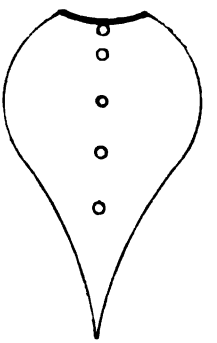
Fig. 6.

about a litre (say $1\frac{3}{4}$ imperial pints) with gases, and then hermetically seals the flasks. Thus we have the gases imprisoned in the glass receivers—the molecules cannot get out.

The upper part of the glass flask is dished or saucer shaped. He pours into the saucer some liquid air. It immediately, as Prof. Dewar calls it, "boils" away into the gaseous form, fig. 5. The air molecules when

[1] Royal Institution Proceedings, vol. xv. No. 90, 1896, p. 136. "On New Researches on Liquid Air," Prof. Dewar, F.R.S.

[2] *Idem*, vol. xiv. No. 87, 1893, p. 11. "Liquid Atmospheric Air," Prof. Dewar.

placed in the saucer are very minute, *i.e.* of very low temperature (estimated when "boiling" by Prof. Dewar at a temperature −190° C.). These molecules immediately begin to expand by the absorption of Ether. To get this Ether something must be robbed of Ether. This something is firstly the atmosphere surrounding the boiling air which is chilled, and secondly the glass of the upper part of the receiver. The latter become so cold that the gaseous objects—atoms or molecules—inside the receiver become attracted to the bottom of the dished part of the receiver (*a*), they give Ether to it which is seized by the liquid air molecules to permit them to become gaseous, and thus a current of Ether is set up and the whole of the gaseous objects inside the receiver lose Ether and become solid.

Two remarkable experiments may be noticed. One with the element Chlorine (a faint yellowish green gas, deep green as a solid) has the following reactions: Directly the air has "boiled" away the saucer immediately begins to return to the temperature of the atmosphere which was the temperature before the experiment was made, hence the upper part of the receiver again seizes the Ether from the atmosphere and chills it. As it returns to the normal temperature, the solid Chlorine seizes the Ether from the dished part of the receiver and returns to the gaseous condition, but before doing so passes from the solid into the liquid form. It falls from beneath the dished part of the receiver drop by drop, as illustrated in fig. 6, and then from the liquid the Chlorine becomes gaseous. Thus the cycle of changes is complete.

With the element Bromine (which in the gaseous state is red and a deep red solid) there is not the

same reaction as with Chlorine. Bromine does not liquefy, or if it does the liquid expands into the gaseous so quickly that the liquid atoms cannot be seen to collect together to become drops of liquid as in the case of Chlorine.

Now this is the point to study: the "boiling" of liquid air is *intense molecular motion* and produces such cold (−190° C.) as to freeze and solidify the gases. *How then can molecular motion be heat?*

The experiments are exhaustive and fatal to the kinetic theory. Is it not wonderful that the specialists —the physicists—with these experiments before them, can believe in the obsolete dogma—the kinetic theory? that is: *heat is not only molecular motion, but the greater the motion the greater the heat, and the less the motion the less the heat!*

Prof. Dewar calls this molecular motion the "boiling" of liquid air, apparently associating the expression with the phenomenon of boiling liquids by the application of heat—as for instance the boiling of water by incandescent fuel. There is a vast difference between the two phenomena. Water is boiled by means of chemical reaction—combustion, producing *an excess* of free Ether which attacks the water molecules until they become so surcharged with Ether that immense molecular motion is produced and the water is then said to boil. It is a true *push* or *pressure* of Ether upon the water molecules.

The so-called "boiling" of liquid air arises from the *innate power* of the liquid air molecules to revert to their normal condition—gaseous molecules. It is a *defect* of Ether. In order to obtain this reaction the liquid air molecule must attract and absorb Ether—it

is a true *pull* of Ether. The difference is very important. During the reaction the molecules are all alive.

Then Prof. Dewar, recognizing the passive condition of molecular matter at absolute zero or at very low temperatures, that is when molecules are devoid or nearly devoid of Ether, states "at such low temperatures they seemed to be drawing near what might be called 'the death of matter' so far as chemical action was concerned."[1] The term "death of matter" should rather be "the sleep of matter," because when atoms or molecules at very low temperatures or at absolute zero again seize Ether their chemical activities revive. There is no death to the energies of the atom or molecule, what appears to be death is temporary inertness only.

The evidence points to the fact that all matter devoid of Ether, that is, at absolute zero, is incapable of chemical reaction. Thus Profs. Moissan and Dewar state: "Modern research has, however, revealed the fact that the most powerful chemical affinities are completely suspended by allowing substances to come into contact at very low temperatures, and it appeared possible that even fluorine, which has the most powerful chemical activity of all the elements, might be manipulated in glass vessels under such conditions." They then go on to prove that, with fluorine, at low temperatures, this is a fact with some few exceptions.[2] If a lower temperature than $-210°$ C. could be obtained, these exceptions would probably cease to exist.

[1] Proceedings Royal Institution of Great Britain, vol. xiii. No. 86, 1893, p. 698.

[2] Proceedings of the Chemical Society, No. 183, 1896-7, p. 175. "On the Properties of Liquid Fluorine," by Profs. Moissan and Dewar.

"When the temperature of the mixture of liquid oxygen and fluorine is allowed to rise slowly, the oxygen evaporates first" (see text, p. 63).[1] This shows there is an atomic or molecular selective power for Ether—a most important deduction.

If a battery, an electric pile, be placed under conditions that it cannot obtain Ether, that is immersed in liquid oxygen, or oxygen molecules nearly devoid of Ether, no electric current exists.[2] This tends to the view that electricity is the motion of Ether (see text, p. 54).

Absolute alcohol submitted to the temperature of liquid air is so robbed of Ether by the liquid air that it becomes solid and hard—ice, and will not ignite in contact with the flame of a Bunsen burner.[3]

Photography is dependent upon chemical reaction, induced by means of light. Now Prof. Dewar shows that this reaction is suspended at low temperatures, so that a sensitive bromide paper is "untouched by the light."[4] This tends to the view that light is the motion of Ether, or is the reaction of Ether on the molecule. Now all these experiments negative the dogma of the kinetic theory, and entirely support the view enunciated in the author's work, "What is Heat?" and in pp. 53 to 66 and fig. 5 in the text. It is absolutely impossible to overrate the importance of

[1] *Idem*, p. 182.

[2] Proceedings of the Royal Institution of Great Britain, vol. xiv. No. 87, 1893, p. 11. "Liquid Atmospheric Air," by Prof. Dewar.

[3] *Idem*, p. 12.

[4] Proceedings of the Royal Institution of Great Britain, vol. xiv. No. 89, 1896, p. 669.

this issue, for the understanding of these reactions gives the foundations of definite ideas.

. . . . . .

It is very remarkable how perfectly unable the physicist is to grasp the fundamental idea. Thus, an eminent Professor of chemistry in his discourse "On Liquids and Gases"[1] states, "when a gas is compressed it is heated. Work is done on the gas, and its temperature rises." Such is obviously not the case, if temperature is volume as in the air thermometer. When the gases are compressed in the cylinder the gases lose temperature, *but the cylinder gains temperature, i.e. as the gases lose Ether the cylinder gains Ether.* This latter fact is the cause of the error in conception.

Again says this Professor in the same paper, "The measure of work is then the weight, multiplied by the distance through which it is raised."[2] A most remarkable conception! Take a three pound weight, raise it three feet, and then try to multiply the three pounds by the three feet distance and it is found that this can only be done on *paper!* (see p. 41). In really intelligent minds—such as every one respects—such erroneous ideas are very wonderful.

[1] Proceedings of the Royal Institution of Great Britain, vol. xiii. No. 85, 1892, p. 369.

[2] *Idem*, p. 373.

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